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Transpecuniary Incentive

In plain English, this long word means incentives "other than money" and it loomed large at the third productivity conference organised by the British Steel Founders' Association. The president, Mr. T. H. Summerson, like everybody else, was impressed with the importance of this subject, so much so that he has communicated the views of the conference to the Chancellor of the Exchequer. The type of transpecuniary incentive discussed at the conference was "an attitude of mind which enables a workman to look through and beyond the symbols of £ s. d. and to visualize the outcome of his endeavours in terms of the actual things which his money can buy"—this is a quotation from Mr. Summerson's letter to the Chancellor.

Other people in the industry have given thought to the same subject and one ironfounder has estimated that if there was a row of shops just outside his works selling motor cars, television and radio sets and the like, his production would increase by 15 per cent. on that account alone. Another suggestion was that large firms should exhibit this kind of equipment in their works and help the men to acquire it, taking care, of course, not to contravene the Truck Act and other laws. Such action would go far towards implanting on our workmen something analogous to the "American way of Life." It may be that as the conditions return to something approaching normal, salesmen will again assert themselves and by their appeals—which have largely been absent for the last decade—create markets amongst the operative class for their goods. At the moment, too much money—possibly as the result of advertising—is finding its way into the pockets of the bookmaker. The influence of advertising in creating a desire for goods is profound, especially in America, where, no doubt, it has been an important factor in high productivity at a national level. It has a dual effect towards creating this transpecuniary incentive on a very wide scale, for it both increases the advertisers' production and the productivity of buyers—as they are some other firm's employees.

The most desirable feature, and one which was stressed by Mr. Summerson in his letter to the Chancellor, was a serious reduction in Purchase Tax, as many of the goods which appeal to the men and their wives are placed beyond reach at the present price levels. With present conditions, would-be buyers of goods carrying purchase tax refrain from placing orders, as they have always a fear that this tax is not only of a transient, war-time nature, but a variable one, subject to decrease or increase following political expediency. We are convinced that the intelligent workman no longer believes that high production by one man, gang or firm, puts others out of work. The thousands of jobs for garage men have been created by the high productivity of the motor industry, and prior to the last war, many of the operatives in the large motor-car works owned their cars. Better and more intensive salesmanship, plus lowered or removed purchase tax, would go far to provide the essential urge to increased productivity.

LORD DUDLEY GORDON

Chairman of Hadfields Limited, Sheffield, and J. & E. Hall Limited, Dartford

Leaders of the Industry

LORD DUDLEY GORDON

LORD DUDLEY GORDON was born on May 6, 1883, the second son of the seventh Earl, and later first Marquess of Aberdeen. He is heir presumptive to the second Marquess of Aberdeen. He received his earlier education at Cargifield, Edinburgh, and at Harrow. On leaving Harrow, though he had taken the appropriate examinations for going up to Cambridge, he went direct to Hall Russell's shipyard at Aberdeen, where he served in the various departments in the shipyard, including the drawing office, for a period of three years. Thus having qualified as a craftsman, he joined a trade union, "The Shipwrights' Society." In 1905 he went to W. H. Allen, Sons & Company, of Bedford, where he was a pupil for 18 months and went through the usual engineering departments and was afterwards, for a short time, employed on the technical staff. In August, 1907, he joined J. & E. Hall, Limited, of Dartford, where again he had a period of training in the shops and on outside erection work, both in various shipyards and in land work. He became an executive of the company in 1909 and a director in 1910. At that time he took charge of the land refrigeration section of the business and in 1912 became a managing director. From 1914 to 1918 he served in France and Belgium with the Gordon Highlanders, and was awarded the D.S.O. in 1917. He became chairman of the company in succession to the late Mr. H. J. Ward in 1936 and continued in charge of the land work until 1945.

He was appointed a director of Hadfields, Limited, in 1943 and succeeded Sir Peter Brown as chairman in July, 1945. He is also director of Barclays Bank, Limited, Gravesend & District Ice & Cold Storage Company, Limited, Jacques Orchestra, Limited, Industrial & Commercial Finance Corporation, Limited, and Phoenix Assurance Company, Limited. He is chairman of the finance committee of the Federation of British Industries, a member of National Production Advisory Council for Industry, governor of Harrow School, chairman of the Bach Choir, and a member of the executive of the British Iron and Steel Federation. He was president of the British Association of Refrigeration 1926-29, president of the British Engineers' Association 1936-39 and president of the Federation of British Industries 1940-42. He was elected a member of Council of the Institution of Mechanical Engineers in 1940, vice-president in 1944 and president 1947. This year he was elected president of the engineering section of the British Association.

It is topical to recall that he was Gold Staff Officer at the Coronation of King George V in 1911 and also at the Coronation of King George VI in 1937.

Lord Dudley finds recreation from his busy industrial activities in choral singing, golf and shooting. He is president of the Allied Circle, and a member of the Bath and Sheffield Clubs.

B.N.F.M.R.A. Open Week

Last week, the laboratories of the British Non-Ferrous Metals Research Association at Euston Street, London, N.W.1, were opened for inspection to visitors, and attendance totalled 700 over the period. On Monday, 40 members of the Press were received and during their visit were addressed by Dr. Seligman (of A. P. V. Limited), a member of the Council, who reviewed the aims and achievements of the Association. On Tuesday and Wednesday, the premises and work in progress were viewed by representatives of member firms, these numbering 440. Thursday's parties included 25 from the Institute of Metals and visitors from other research associations or Government science departments, with, in the afternoon, university representatives and members of firms interested in joining the Association.

The research association movement is a peculiarly British institution. It started shortly after the first world war, the object being to provide a means for firms within an industry to co-operate for the investigation of technical problems of common interest, aided by a certain amount of financial assistance from the Government. The B.N.F.M.R.A. was one of the first associations to be set up. It started in a very modest way in 1920 with a membership of only 20 firms and an income of under £6,000. The years have seen a continual expansion both in membership, range of activities and the facilities the association provides. Today, there is a large laboratory with a floor area of 45,000 sq. ft. established in the centre of London, maintaining a staff of upwards of 150. Membership has risen to nearly 600 firms at home and in the Commonwealth, and the income is now about £128,000. Three main services are undertaken. First, a laboratory and organization for conducting co-operative research and exchanging technological information; second, a free, confidential consulting service to give assistance with individual technological problems and, third, an up-to-date information service and library covering the world literature on non-ferrous metallurgy. There are at present 42 major research projects under investigation in the laboratories. Last year, members received help in connection with about 980 technological problems, and the Association's library made nearly 10,000 loans in response to members' requests for information.

Researches in Progress

Researches in progress at the moment range from subjects like the effect of new detergents on zinc-alloy die-castings used in washing machines, to more spectacular subjects like the evaluation of the properties of titanium and its alloys—a new metal as strong as steel but only half as heavy. The prevention of corrosion, the enemy of all metals, naturally plays an important rôle in the Association's research programme. The association has long held a leading position in the field of techniques for the spectrographic analysis of metals and to the existing three spectrographs in the laboratories there has recently been added an American Quantometer—a direct reading spectrograph, capable of estimating up to 16 elements in a given sample within a matter of a few seconds. Other researches in progress by the association, which are of particular interest to founders, include the following subjects:—Mechanical properties of non-ferrous alloys; grain-refinement of cast copper alloys; refractory linings for melting copper and high-copper alloys in Ajax-Wyatt furnaces; improvements in copper-alloy foundry practice; soil corrosion of aluminium and its alloys; properties of aluminium/magnesium silicide alloys; properties of complex aluminium bronzes; removal of lead from copper; creep properties of gunmetals; particle size of "intermetallics" in cast and wrought light alloys; permissible zinc limit in cast aluminium/silicon/copper alloys; control of gas content in die-casting of light alloys and the creep and impact properties of zinc-alloy die-castings.

(*Concluded at foot of column* 2)

B.S.F.A. Customer/Founder Convention

As previously announced, the British Steel Founders' Association is to hold in London, at 45, Park Lane, W.1, from April 15 to 17, its first customer/founder convention. Apart from technicians and other representatives from the steel foundry industry, there will be present at the convention engineers, designers and metallurgists from industries which are users of steel castings.

The convention will comprise a series of sessions at each of which a discussion will be preceded by the reading of a paper. In all there will be five main sessions, the subjects being: "Steel Castings and their Application," "Customer Experience with Steel Castings," "Quality Control and Inspection as part of the Manufacturing Process," "Research as it affects the Customer," and finally, "Policy Making and Fact Finding." As a background to these discussions there are to be staged, within the same building, two exhibitions, one devoted to metallurgy and design and the other to the use of steel castings. It is intended that delegates from user industries shall not be lectured by steelfoundry representatives, but rather that the discussions shall be open to all on an equal basis, and, above all, frank.

As the title implies, the two papers which are to be read at the second session will be given by representative users, and this session will naturally, therefore, be devoted to discussion of the problems which arise in the use of steel castings.

This convention is in some respects an experiment; out of it there could develop a new approach to trade relations as between customer and supplier, into which there could enter a greater element of confidence to put an end to the cat-and-mouse relationship which not so long ago was the inevitable situation existing between buyer and producer of castings. The complexity and cost of modern machines are ever increasing; and if technology is not to overshoot its economic mark, a very much closer partnership must be established between the scientist, the designer, and the production engineer.

Institute of Welding

The Spring meeting of the Institute of Welding is to be held this year in Sheffield from May 7 to 9 inclusive, and is being organized in co-operation with the Sheffield branch. The provisional programme includes works visits to Steel, Peech & Tozer, Firth-Brown Engineers, Limited, Robert Jenkins & Company, Limited, Firth-Vickers Stainless Steels, Limited, and Newton Chambers & Company, Limited.

Papers on the welding of certain heat-resisting steels; welding for the gas industry; developments in weldable high-tensile steels; and cracking in stainless and heat-resisting weld metals, will be delivered. Enrolment must be made with the secretary of the Institute, at 2, Buckingham Palace Gardens, London, S.W.1, not later than April 13.

A Modern Stove Foundry

By A. R. Parkes

Foundries devoted to the production of stove-grate castings have so often developed from layouts designed for castings quite different (and therefore not particularly suited to the job), that it is interesting in contradistinction to survey the layout and working methods of one equipped specifically for the purpose. Such a foundry is that of Aga Heat, Limited, at Ketley, Shropshire, which is described in this article.

After the war, the expanding production of the "Aga" cooker rendered the existing foundry premises of the firm at Smethwick, Staffs, inadequate for meeting the needs of the time and totally incapable of any enlargement which might be visualized in the future. Thus, the Group's production of agricultural implements was concentrated at the Sinclair Iron Company's works, premises at Ketley in a somewhat industrialized corner of Shropshire were allocated to Aga Heat, and a new foundry for providing the necessary stove castings was built on an almost virgin site of 16 acres, production commencing in June, 1947. The firm is one of the "Allied" Group of twenty-two foundries and there were obviously adequate funds available, with the result that a really well-designed plant has been erected—operations of vitreous enamelling, cooker assembly, etc., being contiguous to the foundry.

Fig. 1 is a layout plan of the works, now covering about four acres, from which it will be realized that the production flow-pattern follows roughly the shape of a question mark, as shown by the superimposed arrows. Raw-materials arrival, storage and melting is arranged towards the upper right-hand half, metal distribution and moulding across the right-hand end, dressing-shop and casting stores, respectively, progressing leftward along the near-side of the illustration, enamelling in the middle and machining, assembly and despatch along the top left-hand leg. The foundry itself is about 65 ft. long, the enamelling shop 50 ft., with machine-shop, assembly and packing 85 ft. A quite recent extension is the extreme left-hand block which houses new inspection and despatch departments.

Types of Production

To help in appreciating the arrangement as a whole, as well as the methods of working of the plant, it should be borne in mind throughout that it is designed to produce on a repetition basis vitreous-enamelled grey-iron castings for assembly into a quite restricted range of finished domestic cookers of the solid-fuel-fired variety, definitely classed among the aristocracy of their type. This involves the production of longish runs of mainly flat, uncored castings weighing from a few pounds to 40 lb. maximum and, say, 40 by 25 in. area, in metal of sections varying from $\frac{1}{4}$ to $\frac{1}{2}$ in. Notable exceptions to this generalization include a rainwater-head casting with a cod of about 10 in. (for an associate company) a cored one-piece boiler section about 8 in. deep by 16 in. dia., for a small thermostatically-controlled boiler and "lumpy" castings

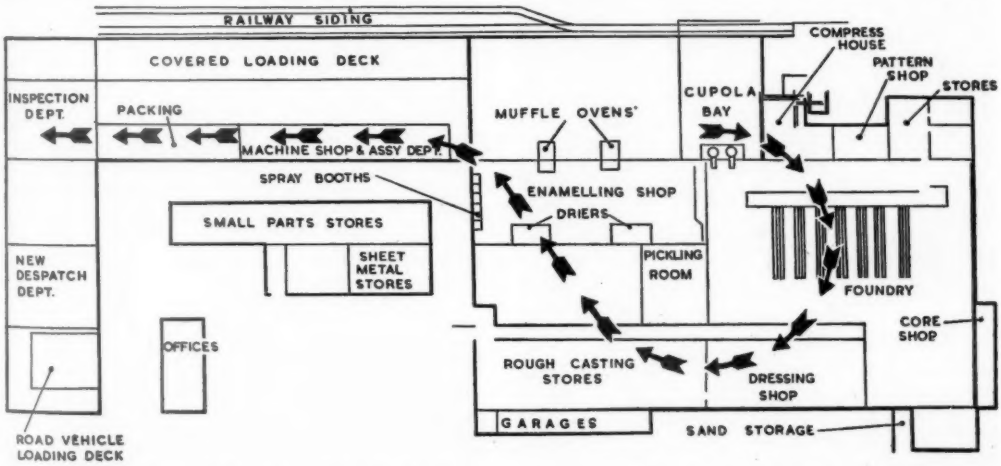

FIG. 1.—*General Plan view of the Ketley Foundry of Aga Heat, Limited. The Black Arrows show the direction of the Main Production-flow Scheme.*

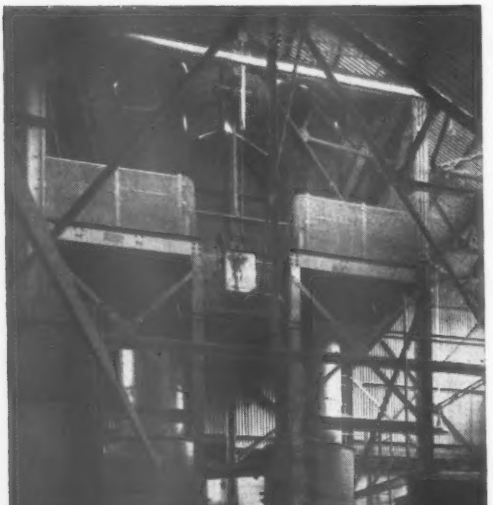

FIG. 2.—*External View of the Cupolas, at Floor Level, showing the Hoist Charger. The Furnaces each have a Melting Capacity of 3 tons per hour.*

FIG. 3.—*Furnace Charging, from Platform Level, showing the Hoist Skip being tripped, so as to discharge its Contents into the Furnace Shaft.*

for the "simmering spot" and thermostat housings, in particular, of one of the standard cookers.

Much of the plant installation at the new works was, of course, sub-contracted to well-known specialist firms, including the Marco Conveyor & Engineering Company, Limited, for the sand-handling and reconditioning plant, Pneulec Limited for the Nichols-type moulding machines and Broom & Wade for the compressors. A similar procedure was adopted in the enamelling and dressing shops and all other ancillary departments, so that the whole is an embodiment of precision-built machinery, well-tried and tested for trouble-free running.

The foundry was started-up by employing at key points in the shops the personnel who had helped to build it—accounting for 33 per cent. of the total of 200 or more now on the payroll. Of the total, 75 per cent. are original employees. Most of the jobs enter the semi-skilled category and semi-mechanized is the term best suited to describe the layout and methods followed. One result of the skilful choice and training of personnel is that there has been a remarkably small turnover of labour throughout the foundry's existence. The whole works is well ventilated, exceptionally roomy, and conditions are congenial. A 44-hr., 5-day week is worked—in the foundry, this means that metal is available for continuous casting from 7.30 a.m. to 12 noon (after a 7.0 a.m. start on moulding) and again from 12.30 to 4.30 p.m. daily except Friday, when only 8 hrs. are worked.

Cupola Plant

The pair of cupolas, situated as shown in Fig. 1, have a present melting rate daily of 24 tons, each

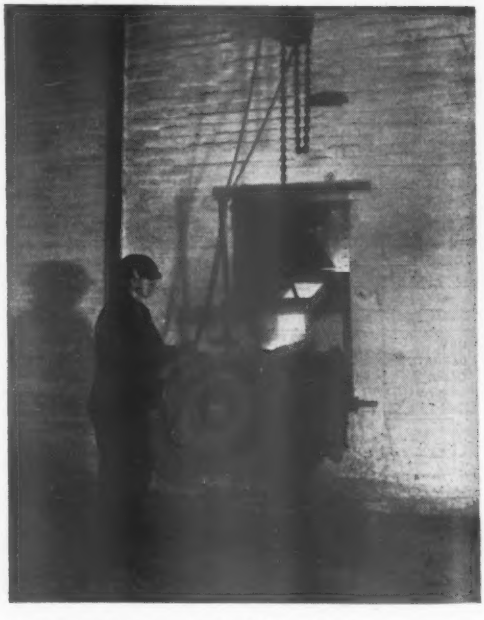

FIG. 4.—*Collection of Metal in a 10-cwt. Barrel Ladle from the Cupola Spout, which projects through a Partition Wall.*

on alternate days. They are Pneulec built to Balanced-Blast designs. When first installed, at 24-in dia., they produced 16 tons per day, but they are now running at about 3 ft. internal dia. and the melting rate is about average for this size. The cupolas are fan blown, from twin fans mounted at ground floor, but the balanced-blast control arrangements are not fully utilized. A view of the furnaces is shown in Fig. 2, in which the charging arrangement, too, is clearly visible. Raw materials are wheeled to the hoist and loaded into its skip. This vertical charger, which is of Asea make, and one of the first of its type installed in this country, has proved very satisfactory in use. Fig. 3 shows the way in which the skip is discharged through the charging door of the cupolas, by left- or right-hand trip discharge, the whole sequence from ground to ground being entirely automatic and push-button controlled. As a standby, charges for one day's melt are retained on the cupola platform, and there is a spare hoist, but these arrangements have only very rarely been made use of.

The melting plant is staffed by two cupola men—who share the duties of operating and patching—with the help of one labourer, and there are two men on feeding the charger. Metal—that is, scrap and pig-iron—as well as coke and limestone is stored adjacent to the charger in silos constructed of used railway sleepers. Rather like the way in which wooden breakwaters seem to withstand the pounding of the sea better than some concrete ones, so have these wooden silos given better life than their concrete counterparts elsewhere. The cupola charge of 750 lb. consists normally of about 300 lb. pig-iron, 250 lb. bought scrap and 200 lb. shop returns, but, owing to the pig-iron shortage, the pig-iron content has currently been reduced and ferro-silicon additions

FIG. 6.—*Typical Pattern Layout on One of the Moulding Machines.*

FIG. 5.—*One of the Nicholls-type Moulding Machines, of which Six Pairs are Installed.*

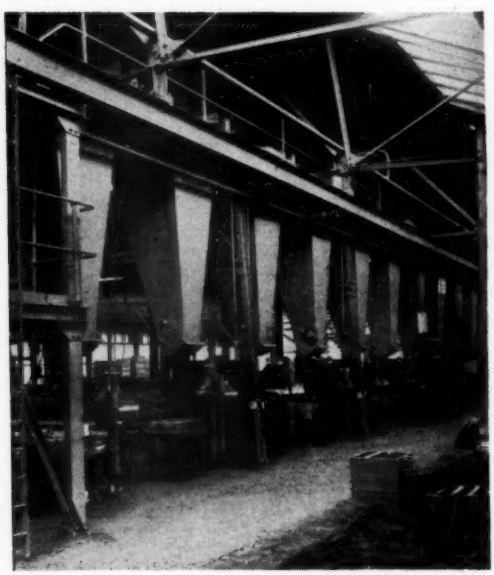

FIG. 7.—*General View of the Moulding Machines and the Hoppers for Overhead Sand Supply.*

FIG. 8.—*One of the Knock-out Stations. With Fairly-thin, Un-cored Work, only a comparatively small amount of Fume is Evolved.*

made. Fortunately, the scrap availability has improved of late. A metal composition aimed at is:—T.C. 3.2, Si 2.8 to 3.0, P 1.0 to 1.2, Mn 0.7, and

FIG. 9.—*Part of the Dressing-shop at Aga Heat, showing the line of Double-ended Grinders; these are shortly to be re-arranged to give space for Truck Movement between each.*

FIG. 10.—*Finished Castings' Stores and Shop for Machining Prior to Enamelling.*

S 0.05 per cent. Raw material purchases are in the hands of the Group's central authority in Scotland.

Check analyses are carried out on the metal and other raw materials at another of the Group's works close by, as and when necessary, but it is emphasized that the policy of the works is to set controls at values established to give optimum operating conditions and then *leave well alone*. Another worth-while feature of the plant is that the ends of the cupola spouts project through a partition wall, so that melting operations are kept safely separated from other foundry processes (see Fig. 4). Metal distribution is by barrel-type ladles of 10 cwt. capacity, carried by geared pulley-block tackle from overhead runways arranged in an endless loop. In contrast to much of the plant, this was constructed by the firm's own engineers.

Moulding

Adjacent to the pouring loop, there is space for about half a dozen floor moulders working with plate patterns, but this really only represents a very minor production, by far the major output of castings being secured from the mechanized moulding set-up. There are six pairs of moulding machines (see Figs. 5 to 7), each pair staffed by three men —one on "tops," one on "bottoms," and one on closing and returning box-parts. Each pair of machines is served by a bank of roller conveyors running across the foundry. These are arranged as three "legs," the two outer "legs" receiving moulds from the machines and the centre "leg" being used for returning the box-parts. Moulds are first placed and closed on one of the outer "legs" until it is full to capacity (about 25 boxes) and then these

are poured (from hand-shanks supported on a monorail, replenished from the barrel ladles), and pass after solidification to the knock-out station at the end (see Fig. 8) during which time the second outer "leg" receives its quota of moulds. Box sizes average 22 by 17 by 5 by 5 in. and the box-parts are made of aluminium alloy.

Cores

For a few jobs "lifters" are incorporated, but cores are only used *when absolutely indispensable.* This practice represents a positive policy of the firm, for the management consider cores to be expensive and inaccurate luxuries for much of their class of work. Instead of cores, simple devices such as chaplets, hinged loose-pieces on the patterns, and other well-thought-out expedients are incorporated in layouts as planned. For the whole coremaking, but two men are employed and much of their output is of annular ring cores for the cast "boiler," on which production is now expanding. Thus, facilities for coremaking are deliberately of the simplest and no mechanical equipment except a small coreblower has yet been provided. A quite weak natural sand is used for the majority of such cores as are made.

Sand Systems

Part of the secret of making good castings for enamelling is recognized to be in efficient use of moulding sand, and that to Aga Heat Limited means no skimping first and foremost, but little waste afterwards. The foundry is served by a reconditioning plant for backing sand, built and installed by Marco Conveyor and Engineering Company,

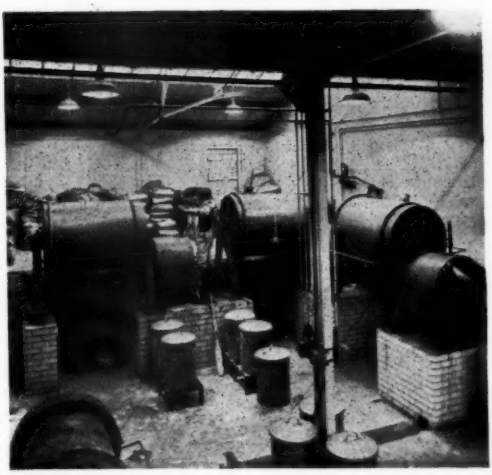

FIG. 11.—*Mill Room for Vitreous Enamels; Ready-prepared Frits are purchased.*

Limited, which incorporates the usual supply overhead to the machine hoppers (Fig. 7) and underground return from the knock-out station (Fig. 8) to the treatment plant. This is giving every satisfaction, despite the fact that increasing output and, in particular, higher metal-to-sand ratios are straining the facilities for cooling the sand before its return to the machine hoppers. The layout of this sand system is on fairly orthodox lines—starting from a 30-ton storage hopper, there is a rotary feed of sand

FIG. 12.—*Part of the Spacious Enamelling Shop, with one of the Fork-type Furnace-loading Machines in the Foreground.*

FIG. 13.—*Spray Booths for applying the Wet-type Enamels.*

through a Royer, and then belt elevation to the distribution conveyor above the machines. Here the backing sand is ploughed off manually from above into the machine hoppers as required. From the knock-out grid, underground collection belts redeliver the sand to the storage hopper, after passing a magnetic separator and a rotary screen. There is no milling of the backing sand. A special feature is made of cooling the sand on the return belts. This is done by shaped ploughs fixed at intervals, for churning up the sand, while a current of air helps to remove steam. Temperature measurements of the sand on the belts before and after the churning gadgets have shown the efficacy of the device. Nevertheless, hot sand is still somewhat of a problem when the shop is on full production, and as a help towards a solution an additional 30-ton storage hopper is to be incorporated. This will double the amount of sand in the system. If necessary, of course, the sand can be kept moving round the system, by-passing the machine hoppers, while the rest of the plant is idle and this is an extremely efficient means of sand cooling.

Additions of red sand, some from Bromsgrove and some obtained locally, but both purchased milled ready for use, are made to the system sand from a special, variable-speed additions-belt at the end of the conveyor line at the knock-out.

Facing Sands

High-quality facing sand is used generously for all work, and especially for the production of castings destined for vitreous enamelling. It is prepared separately in a Pneulec batch-type mill. The mill is mounted about 10 ft. above floor level and delivers sand directly through a rotary aerator into a drop-bottom container. This container is picked up, using a specially-modified Climax fork-lift truck, and the sand is thus delivered to the moulding sites without any handling. Albond clay is used as an additive to the red sand to the extent of 40 lb. per ton of finished castings and these red-sand additions are equivalent to 0.45 tons of sand per ton of castings. No casting is made without facing sand and for some special jobs, two facing sands are used; a typical mixture is 30 parts black sand, five parts milled red, one part Albond and one part coal-dust.

FIG. 14.—*Machining and Fitting Shop; Note the Spacious Construction and well-lit Interior.*

It is interesting to find that elevating the Pneulec sand mill so as to give a gravity feed into the container, in conjunction with sand-distribution by fork-truck, has reduced the labour component of facing-sand mixing from five to two men—that is, one man on the mill and the second driving the truck.

Knock-out and Casting Removal

Pattern runs on the machines average about two days in duration, *i.e.*, nearly all pattern changes are made outside machine production hours. As a further safeguard against lost machine time, there is a spare pair of machines held ready to go straight into production in an emergency and thus absorb a moulding team that might otherwise be idle.

Castings are taken out from the moulds at the knock-out station by a compressed-air-operated "grab-shaker" device made by the firm's own engineers and carried on a jib over the grids. They are then loaded on stillages for removal to the dressing-shop by platform lift-truck. In the dressing-shop, raw castings are treated, first in a sand "Wizard"—an impellor-type, rotary-table blasting plant—and then on Luke and Spencer double-ended grinders (Fig. 9.). A certain amount of hand dressing is also carried out, and the items then pass into the finished castings' stores. A feature which increases the output from the "Wizard" is the careful stacking of much of the load in a canting position on the rotary table.

Other Processing

From the castings stores (Fig. 10), batches are re-issued for further processing in the machine-shops and enamelling department. Prior to enamelling, all castings are annealed in one of the muffle furnaces, and then subjected to high-pressure shot-blasting in a cabinet-type plant, made by St. George's Engineers Limited.

In the enamel shop proper, castings are prepared and "filled" as required and then given three firings for cream enamel, one of ground-coat enamel and two finishing coats. Proprietary brands of frit are used, which are milled on the site (Fig. 11) and applied by spraying in individual booths (Figs. 12 and 13). Prior to firing, the "biscuit" enamel is dried in a static drying chamber heated by an economizer unit, taking hot flue gases from the muffle-furnace stacks. A "wrinkle" which leads to a saving on coal consumption is that warm air from *inside* the shop is fed as secondary air to the furnaces instead of cold air from outside. A year's operation in this manner has shown an appreciable fuel economy. There are ten sprayers (all male) on day-shift work, but 24-hr. working is practised for enamel fusing. Ware is carefully stacked on the perrits for firing. All four muffles are by Hermansen, having hearths 15 by 5 ft., and are coal fired by hand.

Conclusion

As may have been realized from the foregoing account, good organization for production is the worthwhile background to all Aga Heat processing, and the machine-shop, packing and dispatch departments are no exception to this rule. Everywhere there is adequate space, well-lit and airy work-rooms (Fig. 14) and good working conditions. All that is best in foundry amenities and welfare facilities is embodied, including well-fitted washing rooms, with showers, ambulance room and cloak-rooms, as well as a comfortable canteen.

It is small wonder that such careful attention both to optimum conditions for productivity and the "humanizing" of foundrywork is reflected in a high standard of output at the Ketley works, and the Group's success in this direction has indeed set a pattern for the future. In conclusion, the writer places on record his appreciation of the assistance rendered by the directors of Aga Heat, and the executives at the Ketley works in preparing this account.

Putting South-east Asia on its Feet

Great Britain is playing an active part in assisting underdeveloped countries in South-east Asia to take an increasing share in their own development. In training projects that have already cost the participating countries £1,300,000, she has provided 53 experts out of the total of 137 made available to countries in the area; and she has accepted 252 trainees for instruction in this country out of a total of 840. To date the U.K. has offered the services of 90 experts to serve in the area, of which the 53 referred to are out there now or have completed their missions, according to the latest reports of the Council for Technical Co-operation for South-east Asia. Their missions are very varied. Among them are two senior mechanical engineers engaged on the construction of power houses and dams, a tool-room foreman, an orthopædic surgeon, two physiotherapists who are helping to set up an orthopædic department in a Delhi hospital, and a thoracic surgery unit at work in Ceylon.

The U.K. Government has also offered a total of 524 training places. In response to these offers, 252 trainees have already come here and 73 other offers have been accepted. Among them are engineers from India, Ceylonese studying forestry and oil technology, and Indonesians studying labour welfare methods. The National Coal Board is training several students from India and Pakistan, and several of the large steel-making firms, among them Guest Keen Baldwins, Dorman Long, and the Steel Company of Wales, have taken iron and steel trainees from Ceylon and India. Students from Ceylon are studying engineering with Aveling-Barford, Limited, of Grantham. Other students are taking different engineering courses at the Imperial College of Science and Technology, London, Sheffield University, and the School of Metalliferous Mining, Camborne.

The U.K. Government has also received requests from countries in the area for the supply of over £1,000,000 worth of equipment and books for technical training and research. Some have already been supplied and other items, such as machinery and machine tools for the Institute of Technology at Kharagpur, near Calcutta, are on the way. Experts have been sent out by the Government to discuss some of the major requests with the authorities on the spot.

IT IS ANNOUNCED by F. H. Lloyd & Company, Limited, steelfounders, of Wednesbury (Staffs), that the consent of the Capital Issues Committee has now been given to the company's proposed issue of 150,000 ordinary £1 shares. They are to be issued at 45s. a share on a one-for-four basis.

Notes from the Branches

Newcastle-upon-Tyne

About 70 members of the Newcastle branch of the Institute of British Foundrymen were present at a meeting held in the Metallurgy Department, King's College, Newcastle-upon-Tyne, on Saturday evening, March 14 at the invitation of the senior vice-president of the branch, Professor A. Preece, M.SC., F.I.M.

At this meeting Mr. J. A. Reynolds presented a paper on the mechanism of feeding in steel castings, which is the subject of research work at present being carried out at the University. Mr. Reynolds spoke for about an hour on the work done and in progress; he emphasized that while an endeavour was being made to provide a theoretical explanation of what happened when steel solidifies, the experience of foundrymen engaged in the production of steel castings could assist the research very considerably. He showed the effect of shrinkage on two series of experiments in which heads of different area and depth were used on castings of different shape, and described the structure of the steel on cooling, but the research had not advanced far enough to enable reliable conclusions to be drawn. Some discussion followed the lecture, particularly on the effect of rod feeding, and on the influence of atmospheric pressure, and, after light refreshments, the members separated into parties and were escorted by students on a tour of the laboratories.

This is the second occasion that the laboratories of the Metallurgy Department of King's College have been opened to members of the Newcastle branch, through the good offices of Professor Preece, and it is an idea which should be encouraged because it brings together those who are endeavouring to solve some of the foundrymen's problems theoretically and those who encounter them practically in their everyday work. The president of the branch expressed thanks of the members for the privilege of visiting the College and for Mr. Reynolds' paper.

Metallurgical Applications of Thermodynamics

The department of Extra-mural Studies of Birmingham University is holding a week-end school on the subject of "Metallurgical Applications of Thermodynamics," at the University, Edmund Street, Birmingham, on May 1 and 2. The object of the school is to indicate the range of application of thermodynamics to both physical and process metallurgy, and to show how the fundamental relationships in thermodynamics can be used in the design and study of metallurgical processes. The series of lectures will develop the subject from first principles and will emphasize, throughout, the practical rather than the formal approach to this subject. The methods of statistical mechanics will also be used both to clarify the physical principles on which thermodynamics is based and to evaluate thermodynamic functions. Further details will be available shortly, and enquiries should be made to "Director of Extra-mural Studies, The University, Edmund Street, Birmingham, 3.

The Midland section of the Institute of Vitreous Enamellers held a successful dinner and dance at the Star and Garter Royal Hotel, Wolverhampton, on March 20 and approximately 65 members attended. Spot prizes were kindly given by Mr. Ball, Mr. Laithwaite and Mr. Vickery and music was by "The Artisans Quintette."

Working for Better Standards

Speaking at the youth conference of the Amalgamated Engineering Union at York recently, the president of the union, Mr. Jack Tanner, gave a warning that there was a limit to the improvements employers could be expected to give. He told his audience that if they wanted better standards of living they must be prepared to work for them. There were too many people living in this country to-day for anyone to be able to sit back and grow fat, or even maintain their present standard, unless they were prepared to increase production. In appealing for a greater social consciousness and a studied effort to make the nationalized industries work, he said that too many union members were ready to grouse and put the blame on management, and then just leave it at that. Although, in many cases, the management might be at fault, he asked if union members were to be considered entirely blameless. After referring to the policy of nationalization, Mr. Tanner emphasized the need for all workers in industry to understand the existing consultative machinery and to use it properly and to the fullest possible extent. How otherwise could members demand full participation in management if they could not even be bothered to use the powers and rights they had already.

Scottish Hydro-electric Development

The development of hydro-electricity in the North of Scotland has, so far, proved possibly one of the greatest coal savers in Great Britain. In the past three years the production of electricity from water power there has been almost trebled. Current equivalent to a yearly saving of nearly 600,000 tons of coal—about three-quarters of Scotland's annual export of cargo coal—is now being produced. Taking the selling price of export coal as £4 5s. a ton, the country as a whole is being given annually the benefit of more than £2,500,000 of foreign exchange.

These facts are disclosed in the report of the North of Scotland Hydro-Electricity Board for 1952. During the year 889,000,000 units of electricity were generated, compared with 322,000,000 units in 1949. Schemes under construction will provide a further 828,000,000 units a year, and schemes in course of promotion and survey will eventually supply 1,477,000,000 units, making a total production of 3,194,000,000 units.

Unemployment in the Midlands

Unemployment in the Midlands has given rise to anxiety in some quarters. In the House of Commons recently, Mr. Roy Jenkins, M.P. for Stechford, asked the Minister of Labour for an idea of the future of the labour situation in the Birmingham area. He was reassured by Mr. H. A. Watkinson, Parliamentary Secretary to the Ministry, that the position should not cause undue alarm. The Birmingham area remained one of the best employment centres in the country. The figures of about 7,000 on short-time work before the Austin Motors strike and of about 9,000 unemployed on February 16 had to be compared with the total of almost 600,000 insured men and women workers in the area.

The Austin strike has now affected Joseph Lucas, Limited, and English Steel Corporation, Limited, which firms produce electrical equipment and laminated springs, respectively, for Austin vehicles.

The "C" Process of Casting

Discussion of the Paper by M. C. Dixon and R. S. Bushnell*

Vote of Thanks

MR. SHOTTON in proposing a vote of thanks said that no doubt everyone present would like to express their appreciation for a most interesting evening. The record attendance at the meeting was evidence in itself of the interest shown in the subject.

MR. TWIGGER, in seconding, said that anyone connected with foundry matters over the past 20 yrs. must have been struck with the number of developments which had been coming forward. It was difficult to keep pace with them and to size up as to what they meant and how they were going to effect the industry. The demonstration given by Mr. Dixon and Mr. Bushnell had shown something quite normal, but which could revolutionize the foundry. The lecture given had helped to clear up many points and it showed the way to what might happen in foundries in the future. While in America, recently, he had heard that one large American concern had the "C" process in quantity production, and information had been received that there were cases where the process could stand on its own feet and show savings on a production basis.

MR. DIXON thanked all the members for their attitude and the meeting for its attention.

Contraction or Warpage

MR. PRICE asked how much contraction took place in the actual shell mould, and whether the Authors had any idea of the amount of warping, if any.

MR. BUSHNELL said he would not like to give any actual figures but he could say that the shell could be placed back to fit accurately on to the pattern, for it was as near accurate as anything which could be obtained. Warpage could be caused by faulty handling.

MR. DIXON said that the metal being used for the pattern would make a difference to the contraction. He stressed that with a metal pattern there was little likelihood of warpage, so that whatever casting was being made it would still give satisfaction in twelve month's time.

MR. CLARK asked what type of sand was used, and what was the percentage of resin used in each case.

MR. DIXON said that Chelford fine, washed sand was being used and this was well suited for the job. Such sands were rather difficult to get and many had been eliminated as unsuitable. The quality of the casting depended on the resin used, and the percentage was 5 per cent. for phenol—and 8 per cent. urea—for the formaldehyde type.

MR. BUSHNELL said that the Redhill sands also had been found quite suitable.

Cores

MR. HENSHAW called attention to the fact that no demonstration had been given of a hollow core, a subject of which he would like to know more.

MR. DIXON said that time had been so limited that they could not demonstrate the shell and the core that evening, but there was no difficulty in producing a hollow core. A metal mould was required, and that, generally speaking, was divided, and a slush-moulding technique was used. A little extra stoving was needed and a short time was required to divide the box and separate the core. The method was not dependent upon a moulder ramming the sand, and therefore no trouble was experienced with scabbing by over-ramming.

MR. BUSHNELL said he would like to add that a hollow core could be made in a very crude fashion and quite successfully, by merely pouring the resin mix into the heated metal corebox. Mention had been made in the Paper on the question of using air as a ramming medium, to ram the bulk of sand into the box, rather than the conventional method of blowing it in. If this fundamental idea was used, a very good hollow core could be obtained, and in fact this method was being practised very successfully.

Sand Reconditioning

MR. TWIGGER asked whether it was a fact that the sand of the moulds was completely irrecoverable.

MR. BUSHNELL said at present it was generally accepted that the sand was irrecoverable, but he did not hold to that opinion himself, and he thought that means would be found of re-using the sand. From the resin point of view, it would be found that this was all burnt out. Probably, on a second using of the sand, it would be necessary to use more binder. In normal sand practice, when using recovered sand, the body was knocked out and a little more binder used.

MR. HENSHAW confirmed quite definitely that the sand could be recovered and used again.

No Backing Necessary

MR. BRINDLEY said that Mr. Bushnell had mentioned that it was not necessary to back the shells, and asked what size of mould could be obtained without backing.

MR. BUSHNELL said that as far as he knew, all the samples shown were completely unsupported, and moreover technicians of the foundry industry said that backing would be another operation, costing more money, and would be a waste of time.

* Paper printed in the JOURNAL March 26, 1953

The "C" Process of Casting—Discussion

He thought it was fair to say that workers had concentrated on doing the job without supporting the shells before pouring.

MR. DIXON agreed with this, and said he only knew of one foundry in this country which used backing for shells, and that was out of between 300 to 400 firms who were experimenting with the method. He would not say that it was never necessary to back the moulds, but he thought the casting weight limit would be about 2 cwt., above which backing might be required.

MR. BUSHNELL pointed to one sample on view, which had a metal strengthener to prevent it from warping due to its size.

Economical Quantities

MR. WILLIAMS asked what would be considered an economic number of castings to justify the very high cost of pattern equipment.

MR. BUSHNELL referred the questioner to the Paper, where it had been said that cost was a relative matter and had to be checked against normal production costs in individual foundries.

MR. DIXON agreed that it was very difficult to answer the question, but that if Mr. Williams was at present producing castings from green-sand moulds, then obviously it would be difficult to get shell-moulding to be competitive. If he was going to make brass-ware, and polishing operations would have to be done, then the polishing would be reduced if shell-moulding were adopted. He considered that on the bronzes, high-chromium and nickel alloys, all these would probably pay when shell-moulded, and in many cases would be cheaper.

MR. FORD asked at what temperature the "biscuit" mould began to break down.

MR. DIXON had no experience of any casting which had fractured from hot-tears when using a "biscuit" mould. The thickness of shell was determined by the casting. The amount of what might be called static pressure, or the pressure from the feeder head, had a very great influence on the breaking down of the shell, but normally the height of the feeder was reduced to a minimum. It was probably well known that the temperature drop over $\frac{1}{4}$ in. or $\frac{1}{8}$ in. thickness of sand was very considerable, and it was some appreciable time before the temperature of the casting reached the outside of the shell. The inside would break down first.

MR. FORD asked what the actual temperature would be.

MR. DIXON said that it was very difficult to tell. In the core-binding industry, when running light metal, urea formaldehyde resin would definitely be superior, but with steel the phenol formaldehyde binders would have advantages; but he was unable to generalize on this question. The thickness dimensions of the shell had a considerable bearing on this also and, again, the choice of sand would have an effect.

MR. HENSHAW said that, with grey iron, a shell thickness of $1\frac{1}{8}$ in. and a casting thickness of 1 in., the mould did not break down under five minutes.

Research on Sands

MR. WEAVER said he would like to know if the Authors had any experience of research on thermal expansion of the sand grains.

MR. BUSHNELL said that this was a subject that had recently become of importance to the process, and a considerable amount of investigation was taking place with certain sand suppliers, but no details could be given as yet.

MR. DUNLOP confirmed what Mr. Twigger had said about the use of the process in the United States, where considerable savings in man-power were being obtained.

MR. DREW asked whether there was any likelihood of the cost of resins for the process being reduced.

MR. BUSHNELL'S answer to this question was in the negative.

MR. DIXON amplified this by saying that manufacturers could not foresee any great reduction because of the way the resins were made. A second line of attack was to reduce the amount of resin used, and still get the same result, and in this connection it was important that the correct sand be used.

MR. SHOTTON asked whether, if an unsuitable sand was being used, much more resin was needed, and could the necessary strength be obtained. In other words, he would like to know what was the sort of sand which was most suitable.

MR. DIXON mentioned that dune sand was a suitable one, but literally dozens of sands had been investigated. Silica sand was necessary and supplies must be readily available. A search was being conducted for sand deposits which had not previously been quarried or marketed, and prospects were encouraging, but why some sands did not give the results required was not clear. One thing about dune sand was that it did give the finish required.

MR. BUSHNELL assured Mr. Shotton that between founders and research workers every known sand available had been tried. The one shown on the slide, namely zircon sand, made beautiful shells. Any of the well-known sands could be used but those which had been mentioned did, at present, represent the most suitable.

MR. SHOTTON presumed that quality was very largely a question of freedom from clay, suitable grain content and grain size.

MR. DIXON said that baking was carried out at such a high temperature that the clay broke down, but also limonite had quite an appreciable effect.

MR. BUSHNELL said that a certain clay in a sand for shell-moulding might be useful from the point of view of green strength, but, from a dry-strength angle, clay was the enemy of any resin.

MR. LOVERIDGE said that it had been proved that a sand contaminated by iron oxide gave a weaker shell than the same sand with iron oxide removed.

MR. DIXON said that if founders using the "C" method could be more communicative, their experi-

ences with the process would be very helpful indeed, and makers of resins would be happy to receive any information of this kind.

Storage of Sand

MR. PEARSON asked whether the amount of sand put into the bin was sufficient to do several plates, and, if so, whether the last plate to be done was as satisfactory as the first off. Alternatively, did the sand deteriorate?

MR. DIXON said that no deterioration of the sand in the dump bucket took place. Under certain circumstances, which had now been overcome, there was a drop back of sticky sand from the edges of the box which had been heated by contact with the hot patternplate, but this had been overcome and the sand now could be used over and over again.

MR. BUSHNELL said a supply of sand could be made up and stored for several days before being used.

MR. DIXON said that one company he knew of mixed sand at the beginning of the week and continued using the same material throughout the week.

MR. BUSHNELL pointed out that, although it had not been mentioned before in the lecture, some sand mixes could be prepared in advance, and, also, baked cores and shells could be stored.

Shell-moulded Steel Castings

MR. PRATT said that he had found one difficulty in shell-moulded castings, that was a run of pinholes, the defect being more or less confined to plain carbon and low alloy steels. He asked, in view of the higher temperature used for steel castings, if there was any breakdown of the resin in contact with the steel, causing these pinholes to occur. What advice could be given as to suitable sands for use when casting steel.

MR. DIXON said he presumed Mr. Pratt was referring to the carbonization of steel due to contact with the binder used.

MR. PRATT confirmed that he knew of this type of mould being used on low alloy and plain carbon steels, where a large proportion of scrap was obtained due to pinholes.

MR. DIXON said he had not come across this problem; it might be due to resins or to sands.

MR. SHAW asked whether dune sand gave a better finish than other sands and, if so, what was the object of using special sands.

MR. DIXON said that shell-moulding could not compete with black-sand moulding, if this was what Mr. Shaw was referring to, but if the "C" process was being used, then the best materials available should be used and dune sand was one of them. The cost of the sand in any case was negligible. Chelford fine, washed sand was also economic. He thought these sands would come down in price if the consumption was raised.

MR. SHAW asked whether the dune sand gave a better finish than ordinary ironfoundry sand.

MR. DIXON said that King's Lynn sand, which was available in very large deposits, was very much better than dune sand, but the general trend with foundries in this country was to experiment with sands by mixing different varieties, which gave even better results.

MR. MCCLELAND referred to the casting of heat-resisting and stainless steels and said that the "C" method of moulding was undoubtedly a success for these, especially when using zircon sand, because considerable saving could be made on grinding and mopping operations, and the casting could be put straight from the mould on to the polishing mop. Zircon sand seemed to him the best sand to use, bearing in mind the cost of stainless steel, and that it did not pay to use cheap sands where valuable metal was involved.

Was it possible to make impeller castings, for instance, up to 12 in. to 2 ft. dia., with an aperture of $\frac{3}{8}$ to $\frac{1}{2}$ in., by shell-moulding, and, if so, whether the core would stand up to 1,550 deg. C., or whether it would break down before solidification was complete.

MR. DIXON agreed in reply that, although zircon was very expensive, it was very suitable for the process, if high-chromium steels were being used, or other expensive metal. However, there were founders who were using Chelford sand with very great success. Zircon sand had the advantage of being a good heat conductor. With regard to the second part of Mr. McCleland's question, before he could offer any advice he would like to see and discuss the job on the spot.

Pig-iron Records at Colvilles

A few years ago Mr. R. P. Towndrow, works manager of the Clyde Iron Works of Colvilles, Limited, at Tollcross, Glasgow, visited the United States to obtain first-hand information about high-top pressure furnace operation. Impressed by what he saw he at once initiated the conversion of the No. 2 blast furnace at Tollcross. The furnace was due to come out of commission for re-lining, and in 1950 the first pig-iron produced commercially by this system outside the U.S. was tapped from this furnace. Despite many early difficulties, Mr. Towndrow has reason to be proud of this venture. Recently, in one week, 4,584 tons of pig-iron were produced from the 18-ft. 3-in. dia. No. 2 furnace. This record for the works is thought to be unsurpassed by any furnace of the same dimensions in the U.K. operating under post-war conditions of raw material supplies. A second record of 4,379 tons per week during the four-weekly period ended on the same shift was also established. The previous record at Clyde Iron Works of 4,100 tons a week over a four-weekly period in 1946 was made using only high-grade imported iron ore. The latest record was achieved with an ore burden including 25 per cent. of English native ores containing roughly 25 per cent. iron, or about half that of the richer foreign ores. Mr. Towndrow was appointed an executive director of Colvilles, Limited, in January, 1952.

ATHLONE FELLOWSHIPS have been awarded to 28 undergraduates and 10 graduates of engineering faculties in Canadian universities for the third successive year. The purpose of the fellowships is to enable a representative group of Canadian engineers to spend two years in Britain.

Grain-size of Cast Magnesium/Aluminium Alloys

A Paper written by W. A. Baker, B.SC., F.I.M., Myriam D. Eborall, B.A., and A. Cibula, M.A., A.I.M., and covering the review of much experimental work on grain-size in cast magnesium/aluminium alloys, states that although the superheating and carbon processes for the grain-refinement of magnesium/aluminium alloys have now been in use for several years, their *modus operandi* remains obscure. The work described was directed towards determining whether the processes were basically similar or dissimilar, and whether a nucleating substance was responsible for both, or either, of them. Accordingly, the occurrence of primary particles in alloys of commercial and high purity, and their relation to changes in grain-size, brought about in various ways, was studied. Two types of primary particle were found, one an iron-rich phase and the other of unknown identity. The Authors finally record the following conclusions of value to foundrymen.

From experimental evidence it is stated that two types of primary particles are present in molten magnesium/aluminium alloys after superheating under certain conditions. It has been established that the iron-bearing primary particles are not responsible for grain-refinement. There is some correlation, however, between the presence of the unidentified primary constituent and grain-refinement. This correlation is not entirely satisfactory; for example, the effects of varying the flux composition and of carbon grain-refinement cannot be adequately explained by the observed behaviour of the needle-shaped constituent during these processes. Therefore, it cannot definitely be concluded that the constituent provides nuclei for the crystallization of the magnesium-base solid solution.

Superheating

The fact that the grain-coarsening effect of holding at temperatures just above the liquidus is more marked in materials grain-refined by superheating than in materials refined by carbon additions, might indicate that the two grain-refining processes differ in kind. The present work suggests, however, that a single mechanism may be responsible because superheating under conditions designed to exclude carbon did not cause grain-refinement. Moreover, the observations on some primary constituents in the alloys offer a simple explanation of the effect mentioned above, namely, that the iron dissolved during the superheating process precipitates during holding, and the precipitate, settling under gravity, carries with it other particles which would otherwise remain suspended and act as nuclei during solidification.

This view is supported by the fact that, in several other important respects, the two processes have common features. In particular, both appear to work well only with magnesium/aluminium alloys; magnesium, magnesium/zinc, magnesium/manganese, and magnesium/tin alloys do not respond to superheating, and it is reported that the carbon process does not grain-refine the first three alloys.

Additions of beryllium and titanium destroy or prevent the effect of superheating; at least one of these elements forms a very stable carbide, and their effect suggested the possibility that a less stable carbide, the formation of which would be prevented by titanium or beryllium additions, was normally responsible for grain refinement. It has been suggested that aluminium forms a carbide which could provide nuclei for the crystallization of the magnesium-base solid solution.

Lattice Dimensions

A near equality of lattice dimensions has been observed in the great majority of cases of nucleation and formation of oriented overgrowths. The closeness of fit required, however, varies in different cases and, although a similarity of lattice dimensions is usually essential, it is not always sufficient; in particular, the nature of the interatomic bondings, in the substrate and the deposit, exerts a considerable influence, and the presence of strong adsorption bonds between these substances favours oriented overgrowth.

Aluminium carbide appears to fulfil the necessary conditions; this compound has a layer structure in which the aluminium ions occur in hexagonally packed sheets; the closest distance of approach of the aluminium ions is 3.33 A. (at room temperature), which is only 4 per cent. greater than the corresponding distance in the close-packed planes of metallic magnesium (3.20 A.). Also, as magnesium and aluminium form stable compounds, strong adsorption might be expected between the aluminium atoms of the carbide and the magnesium atoms of the magnesium-rich solution. Since titanium does not form stable compounds with magnesium, it may be assumed that atoms of this metal, when present in the carbides, do not form strong adsorption bonds with magnesium atoms in the melt. This may explain why, although the structure of titanium carbide is otherwise suitable for nucleating magnesium overgrowth, no grain-refinement occurs.

The Authors realize that this work is inconclusive and that their understanding of grain-refinement remains incomplete. It can only be said that the needle-shaped constituent has some influence on grain-size and that aluminium carbide could theoretically be the grain refiner. It cannot be concluded, however, that the needle-shaped constituent is aluminium carbide, for it was not detected in materials refined by carbon additions. Indeed, it is possible that the grain-refining nuclei, whether consisting of carbide particles or not, are so very small that the methods used did not reveal them.

Future of Scrap Drive

The national scrap drive must not be allowed to outlive its usefulness and become a competitor of legitimate contractors, Mr. R. M. Paterson, president of the National Federation of Scrap Iron, Steel and Metal Merchants, said at a meeting of the Midland Association in Birmingham recently. The industry might find, he warned, that when the urgent need for scrap had passed, there remained an organization superimposed upon its own Federation, which represented the legitimate trade. He did not think that the authorities behind the scrap drive had any such thing in mind, but some things happened by accident. Mr. Paterson welcomed the disappearance, at least in Scotland, of the black market in cast iron but said the industry must resist any move by foundries to reduce the maximum price.

The annual report of the Association stated that it had been decided to continue the scrap drive during the present year, but it was not intended to put the organization on a permanent basis. Throughout the discussions with the steelworkers' representatives, it had been fully realized that the main responsibility for collecting and processing ferrous scrap rested on the merchants.

Evolution of Vitreous-enamel Formulæ*

By A. W. Murdoch

Starting with earliest known methods of vitreous enamelling, the Author records the types used and ingredients compounded, as one development followed another through the ages. Only comparatively recently has vitreous enamel been applied for industrial and domestic as distinct from artistic applications, but that era, along with parallel development of materials to be coated, heralded many advances in enamelling technique and enamel properties. This process of evolution is still continuing and the Paper closes with hints as to what the future may have in store.

THE CHAIRMAN (Mr. Ball) opened the meeting by welcoming members of the Society of Glass Technology and the Wolverhampton Society of Applied Science, and adding that they had a standing invitation to participate in future proceedings.

MR. MURDOCH, before delivering his Paper, stated that he had made two or three attempts at writing it, as the task had not been easy to record the data without appearing to place formulæ one after another in front of the audience. He also hoped that listeners would not find too much history attached to the discussion, but some effort to link together the different phases and periods chronologically was inevitable. He then continued:—

Historical

It is not the intention to delve deeply into very ancient history concerning the vitreous enamelling industry. This has already been well done by others, but it is necessary to mention briefly some of the very early work. Certain developments over the centuries, either in enamelling technique or formulation, represent a distinct step forward, and it is these periods which it is intended to emphasize. Often, significant developments cannot, with accuracy, be given a definite date, as obviously they must have evolved gradually to the point where they could be used to advantage in enamelling as applied at that particular period.

It should be understood that vitreous enamelling was known to the Egyptians of a very early period, and it has been suggested that in the first processes, small pieces of glass were probably fused into cavities prepared in precious metals. Prior to the 9th century this champ-levé enamelling, as it was called, was carried out on bronze and copper, and then the cloisonné method on gold was introduced. This is generally attributed to the Moors, and powdered glass was placed into the prepared design and fused on to the metal. The composition of these early glasses was probably a soda-lime or potash-lime base and such colouring was used as could be obtained by the use of the crude materials available. The first metal objects to be decorated with a fused-on-glass finish were probably quite small and almost certainly flat, but gradually the size increased and probably the type of metal base used varied during the next 300 to 500 yrs. Copper and silver were probably the metals most commonly used, but always the same method was employed of fusing powdered glass on to built-up (cloisonné) or carved-in (champ-levé) designs.

About the middle of the 15th century, there appeared what was probably the first major advance, in that an opaque glass or enamel, if one may use that word for the first time, was fused into a metal cavity of regular but variable shape, and the actual design required was painted on this base coating. Printing had also been invented and this was applied to the decoration of this white base coating.

Opaque enamels used for the painting or printing base were probably all developed around the tin/lead glaze which may have been known in Italy prior to the 15th century, but it was not until the late 16th and early 17th centuries that a fair, dense white was produced.† Another type of enamel was also appearing about this time. That was majolica enamel which, in Italy, predominated from the early 15th to the late 16th centuries, and probably before this in other parts of Europe but of not such distinct types. The basic composition of these centred around the composition shown in Table I.

TABLE I.—*Basic Composition for Majolica Enamel.*

—	Per cent.	—	Per cent.
Sand	50 to 60	Tin	2 to 4
Potash	12 to 16	Lead	20 to 30

The tin and lead contents varied according to the type or colour of the final majolica.‡ Majolica coloured enamels were obtained by the use of Cu, Sb, and Pb (greens); dark yellows from Sb, Pb, and iron oxide; pale yellow from Pb and Sb; blue from crude cobalt and purple from manganese.

* Paper presented to the Midland section of the Institute of Vitreous Enamellers, Mr. Ball presiding. The Author is superintendent, Ferro Enamels Limited.

† Benson, I. V. E., Proc., 1938, p. 32, quotes: "The formula for the Italian white enamel of the early 17th century is given by Antoine Neri, a Florentine priest, in his 'Art of Glass,' published in 1612, in the 'sixth book' 'wherein is shown the way to make all the Goldsmiths Enamels.' His instructions are perfectly clear. 'Chapter XCIII. The Material wherewith all Enamels are made. Take of fine lead 30 pound, of fine tin 33 pound. Calcine them together in a kiln, and serce (i.e. sieve) them. Boil this Calx a little in clean water in clean earthen vessels, take it from the fire and decant off the water by inclination, which will carry with it the finer part of the Calx, put fresh water on the remainder, then boil and decant as before, repeat this as long as the water carries off any Calx. Take then of this fine Calx, of Crystall Frit made with Tarso (i.e., good soda glass made with pure sand), ground and sereed fine, of each 50 pounds, of white salt of Tartar eight ounces, powder, serce and mix them well; then put this stuff into a new earthen pot baked, giving it a fire for ten hours, then powder it and keep it in a dry covered place. Of this stuff are made all the enamels of whatsoever colours. This shall be called the stuff for Enamels.'"

‡ Benson's Paper, p. 34, "Piccolpasso was careful never to fire his enamels at the waning of the moon 'for the fire will want in brightness as the moon wants in splendour'."

Evolution of Vitreous-enamel Formulæ

Up to the end of the 17th century, evolution brought the art of enamelling from the broken- or powdered-glass era to the time when enamels were being made from workable formulæ and it had ceased to be a by-product of an allied industry. Admittedly, many of these formulæ had been developed from "pottery glazes" or "glass compositions" of the period, but nevertheless enamelling had begun to stand alone. It was at the beginning of the 18th century when, for the first time "borax" was mentioned as an enamel ingredient. It may be, that its introduction was first of all as a flux (three parts sand, three of calcined borax and one chalk) for certain colours which were either unobtainable or unsatisfactory in the presence of lead. However, it is definite that lead was still a major constituent of enamels and continued in use.

Early Applications

During the first half of the 18th century, enamels were being applied to copper in factories at Battersea and in the Birmingham area. There is evidence that plaques, snuff-boxes and the like were also being enamelled at Bilston during the same period. The enamels used were all similar in composition, contained lead and were opacified, generally, with tin, although antimony may have been used in some instances, as also was arsenic (probably in a flint-glass formula). The actual formulæ of the enamels used for the above processes is not definitely known, but was probably typical of the type given in Table II. The frit was ground to a powder which was mixed with water and laid on with a brush on both sides. The copper was of very thin section. A further white enamel for jewellery at this time was, according to Paul Randau, prepared as follows:—

TABLE II.—*Formulæ for 18th Century Copper Enamels (Per Cent.).*

	1.	2.	3.
Sand	25.0	38.0	26.0
Lead oxide	12.5	40.5	44.0
Tin oxide	12.5	14.0	9.0
Potash	50.0	7.5	21.0

> Calcine together two parts of tin and one part of lead and convert to the oxides. Then take one part of the mixed oxides with two parts of pulverized white crystal glass, mix and fuse together with a minute quantity of manganese dioxide or saltpetre as a decolorant. Pour the molten mass into water. Repeat the fusing and the quenching three or four times until the mass is bubble free and homogeneous.

Again, the following is also given:—

> Fuse together 100 parts of the tin/lead oxide with 60 parts of sand or quartz and 25 parts of common salt. Grind to a powder and then mix 50 parts of this powder with 100 parts of tin oxide or of the tin/lead oxide mixture.

The close of the 18th century saw a tremendous step forward, for a start was made in enamelling cast iron. (Hicklings patent for the enamelling of cast iron was taken out in 1799.) At the same time, it was recognized that, with this new base metal, the traditional enamel formulæ would have to be modified. To this end there is a record of the introduction of fluorspar and felspar, amongst other raw materials. The birth of the 19th century began a new era as far as enamels were concerned. Enamelling was rapidly becoming an industry, and ground-coats as distinct from cover-coats were being developed. Up to then, when a "ground" or "undercoat" had been used it was frequently of the same composition as the cover-coat, but this was not satisfactory for iron enamelling, and caused the split into the two distinct groups.

Development of Enamels for Cast Iron

These ground-coats ranged from those which were very refractory and perhaps lead-less, to the easily-fusible enamels, which might contain up to 6 per cent. of a lead oxide. The formulæ shown in Table III are as given by Randau in "Enamels and Enamelling." It will be noted that clay is added to all these enamels at the grinding stage, and although there is no clear indication as to the method of application, it is possible that the powders produced were intended to be mixed with water and possibly brushed on to the iron. Therefore, it could be deduced with fair certainty that these enamels applied to the period after 1850, as the use of clay for suspending enamel powder in water had not been used in the early part of that century. The frits themselves, however, probably resemble very closely those of 40 to 50 yrs. earlier.

TABLE III.—*Nineteenth Century Formulæ of Ground-coat Enamels for Cast Iron (parts by weight).*

—	1.	2.	3.	4.	5.	6.	7.
Flint meal ..	30	50	30	30	30	30	20
Borax ..	16.5	30	25	18	15	16.5	9
White lead ..	3.5	—	—	3	8	3	—
Felspar ..	—	—	30	—	30	—	—
Soda (anhydrous) ..	—	—	—	—	12	—	—
Potash ..	—	—	—	—	—	—	1
Magnesia ..	—	—	—	—	—	—	6
Mag. sulphate	—	—	—	—	—	—	2
The above were fused and then ground with :—							
Flint meal ..	25 to 40	—	—	9.5	—	9	—
Clay	20 to 25	13	10.75	8.25	11.75	8.6	2
Magnesia ..	5 to 6	—	1.25	0.90	0.75	0.5	—
Silica	—	13	—	—	—	—	—
Felspar ..	—	—	6.00	—	6.25	—	—
Chalk ..	—	—	—	2.00	—	—	—

These enamels were described as (1) Very refractory; (2) refractory; (3) fusible mass; (4) fusible; (5) medium fusibility; (6) ground mass for iron utensils; and (7) for iron utensils (using mag. sulphate).

The cover-coats for cast iron generally contained lead, and, no doubt, in the early part of the 19th century considerable difficulty was experienced due to the generally poor quality of the available raw materials. Fusibility was of great importance, and probably several coats of enamel were necessary to obtain a suitable finish. It should be remembered that the enamels were frequently applied in the powder form, even after the introduction of clay for floating. Opacification was derived chiefly from

tin oxide in the melt, as well as by a frequent addition of this material at the grinding stage.

Lead-free cover-coats were made, particularly for use on food utensils, and a class known as felspar enamels added much to the fusibility for this work. Formulæ listing glass or porcelain or

TABLE IV.—*Nineteenth Century Formulæ for Cast-iron Cover-coat Enamels (parts by weight).*

—	1.	2.	3.	4.	5.	6.
Flint meal	37.5	—	88	—	15	10
Borax ..	27.5	48	50	34	26	35
Tin oxide ..	30	50	55	15	13	20
Soda ..	15	22.5	25	—	12	18
Saltpetre ..	10	20	22.5	6	1.5	14
Amm. carb.	7.5	15	15	—	—	—
Magnesia ..	7	10	12.5	—	—	7.5
Silica ..	—	75	—	—	—	—
White lead	—	30	15	—	—	—
Felspar ..	—	—	—	40	20	30
Clay ..	—	—	—	—	—	5
The above were fused and then ground with :—						
Flint meal ..	6.12		12.6		12 to 20	
Tin oxide ..	3.66		—		—	
Soda ..	0.70		—		—	
Magnesia ..	0.7		—		—	

These were described as : (1) Lead-less cover-coat for cooking utensils; (2) lead cover-coat ; (3) lead cover-coat ; and (4), (5) and (6) ready for use without addition when ground, but if too refractory then an addition of borax may be made to the milling.

both in their composition were also in use and said to give good results. Table IV gives a fair cross-section of the type of formulæ in use during the period.

Sheet-iron Enamels

The technique of enamelling was gradually improving, and sheet iron began to be enamelled around the middle of the century. The formulæ first used for sheet-iron enamels resembled very closely those of the cast-iron enamels of the day. Randau recommended using the enamels of highest expansion from the cast-iron range for sheet iron, and no doubt the results so obtained were fairly successful. Ground-coats for sheet iron were usually refractory and often rich in felspar. There were, of course, no adherence-promoting materials used in these enamels, and the bond was dependent solely upon the refractory enamels slagging with the metal.

In this connection it is interesting to note the firing technique given by Randau, when he states that it is best carried out by using two muffles: one at dull-red heat, in which the ware is warmed up, and then quickly transferred to the second muffle, which is at "white" heat, for firing the enamel. When fused, the ware is then either returned to the first muffle to cool slowly or into a special annealing muffle to cool off. Sheet-iron cover-coats conformed to the typical pattern of the time, usually containing lead and opacified with tin, both in the melt and during grinding. Table V shows sheet-iron enamels for a particular purpose, as well as two lead-less enamels specified by Pleischel of Vienna as suitable for sheet steel or cast iron.

Late 19th Century Progress

The latter half of the 19th century showed much progress in the enamelling industry. The discovery of the Le Blanc and the Solway soda process produced good soda ash at a cheap price; borax was manufactured by improved methods; the Stassfurt

TABLE V.—*Early Enamels for Sheet Steel (parts by weight).*

(a) For steel boiler tubes.			(b) As recommended by Pleischel of Vienna.			
	1.	2.	3.		4.	
Quartz ..	66	17	Silica ..	30–50	Quartz ..	30–50
Borax ..	30	22	Flint ..	10–20	Granite ..	20–30
Soda ..	4	8	Kaolin ..	10–20	Borax ..	10–20
Felspar ..	—	32	Pipe clay ..	8–16	Glass ..	6–10
Tin oxide ..	—	14.5	Chalk ..	6–10	Magnesia ..	10–15
Fluorspar ..	—	3.5	Ground porcelain	5–15	Felspar ..	5–20
Saltpetre ..	—	3	Boric acid ..	20–40	Soda ..	10–20
			Saltpetre ..	6–10	Lime ..	5–15
			Gypsum ..	2– 5	Barytes ..	2– 8
					Fluorspar ..	3–10

These enamels were described as (1) High-temperature ground-coat ; (2) requires 20 min. fire at white heat, and (3) and (4) suitable for sheet iron and cast iron.

deposits were investigated (1860) and developed; cobalt oxide was made from the silicate (Saxon Blue Colour Works) and new raw materials and oxides for colours were investigated, so that the quality of enamels was improving not only by formula alterations but also because better-quality raw materials became available. It was found that clay could be used to suspend the enamel powder in water, and the liquid mixture was either brushed or poured on to the metal base. This was of itself a big move towards modern enamelling technique. However, the enamels were still largely of the lead-base type.

In the iron and steel industry, too, progress was rapid. New methods of manufacture were developed (by Bessemer, Thomas, Gilchrist, and Siemens-Martin) and the properties of the metal altered accordingly. Then came the problem that the enamels commonly used were not suitable for the iron and steel being produced, so that basic enamel formulæ had to be revised. It is probable that German technicians were the first to enamel successfully the improved iron and steel, and their formulæ gave rise to a new era in that the lead content of the frits was considerably reduced and frequently eliminated altogether, as were arsenic and other poisonous compounds. Tin oxide became the primary opacifying material. It is, however, significant that even to very recent times some operators in the dry-process enamelling industry used lead or lead/arsenic enamels similar to those of the 19th and 20th centuries.

Present Century

The first 25 years of this present century saw tremendous strides in the enamelling industry. The demand for enamelled articles was increasing, and factories were turning over to using enamel as a finish for the articles they produced. Many of these factories made their own enamel frits at first, but, soon, companies manufacturing frits began to appear. This for the industry augured well for the future, for although to-day some firms still make

Evolution of Vitreous-enamel Formulæ

their own frit, the research and development which has been and is being carried out, and has been or will be published by frit manufacturers must be of considerable assistance.

As this new industry expanded, so the suppliers of the raw materials which it required began to appreciate the potential market, and along with the better-quality ceramic materials, the iron and steel industry developed metal more suited to enamelling. Probably the 1914-18 war assisted in the development of the raw-material position, for much research work was carried out during this period which had a direct relationship to the industry. The shortage of certain materials promoted investigation into their possible substitution by others. Borax-free white enamels were made and used in Europe at this time, and although the finishes were stated to be dull and lifeless, the benefit of experimental work was of great value for the future. Formulæ for this type of enamel are shown in Table VI.

TABLE VI.—*Borax-free White Enamels of the* 1915-1918 *Period* (composition per cent.).*

	(1)		(2)
Felspar	34.6	Felspar	30.0
Quartz	34.6	Quartz	22.0
Soda	19.0	Soda	20.0
Cryolite	11.5	Cryolite	13.0
Sodium nitrate	0.3	Fluorspar	9.0
		Calcium carbonate	3.0
		Sodium nitrate	3.0

* Reference—" Enamels," L. R. Mernagh.

Sheet-steel ground-coat enamels were developed in which the adherence property of cobalt oxide was recognized at as low as 0.25 per cent. Nickel was introduced to replace some of the cobalt as it was cheaper, and manganese dioxide also found its way into ground-coats with Ni, or Co and Ni, the amount frequently being as little as 0.1 per cent., but also varying up to 1 per cent. There is also some mention of iron-oxide ground-coats, where this was the only colouring ingredient and this may even have been before the cobalt ground-coats.

Certain types of enamels were by then established —the cobalt/nickel type ground-coats for sheet iron and steel, clear and opaque white cover-coats, sintered ground-coats for cast iron and cover-coats formulated to suit them. White ground-coats for sheet iron and steel particularly were also introduced but their popularity was limited. Although it was stated that only one white cover-coat was necessary over the white/grey ground-coat, the darker-coloured cobalt and nickel ground-coats were preferred, although two or even three coats of white cover-coat were necessary. Table VII gives three examples of this class of ground-coats.

TABLE VII.—*White Ground-coats for Sheet Steel in the Early Years of this Century (composition per cent.).*

Material.	1.	2.	3.
Borax	32	28	26
Felspar	20	15	18
Quartz (or sand)	23	20	22
Soda ash	5	9	6
Potassium nitrate	4	—	—
Cryolite	7	6	12
Sodium nitrate	—	7	4
Fluorspar	2	3	6
China clay	3	4	—
Antimony oxide	4	5	—
Zirconium oxide	—	3	6

Many of the sheet-steel cover-coat enamels of the early 20th century were of simple composition, probably consisting of (per cent.) about 30 borax (hydrous) cryolite 10 to 15; felspar 30 to 40; quartz 10 to 20; potassium or sodium nitrate 2 to 6 and soda ash 4 to 8. The whiteness, opacity or covering power of such an enamel was very low and its ultimate opacity was produced by a mill addition of from 5 to 12 per cent. of tin oxide, zirconium oxide or antimony oxide, sometimes separate or so much of each. Cast iron, wet-process enamels were, during this period, still in the process of changing from leaded to lead-less types. Both kinds were used for ground-coats and cover-coats, and typical examples of formulæ are given in Table VIII. The ground-coats were generally very refractory and the sintered lead-less type was popular. The frit in this case might only have been 50 per cent. of the mill batch, while the remainder was quartz and/or clay. The cover-coats for cast iron were again mainly of the high-lead, low-lead and medium-lead types, the lead-less type in use being very similar in composition to the enamels for sheet-steel.

TABLE VIII.—*Typical Frit Formulæ During* 1920-1930 *Period (per cent.).*

	For sheet steel.						For cast iron.				
	Ground-coats.			Cover-coats.			Ground-coats.		Cover-coats.		
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Borax	30	34	28	32	38	28	30	28	20	18	20
Felspar	30	44	36	38	36	25	—	—	8	18	22
Quartz	20	6	16	14	—	20	55	68	28	10	22
Soda ash	9	4	9	6	3	4	—	4	8	—	4
Sodium nitrate	—	—	4	—	2	4	5	—	8	5	7
Fluorspar	4.5	8.5	6	—	—	5	—	—	—	9	5
Potassium nitrate	6	3	—	3	—	—	—	—	—	—	—
Boric acid	—	—	—	—	—	—	6	—	—	2	—
Cobalt oxide	0.3	0.2	0.4	—	—	—	—	—	—	—	—
Manganese oxide	0.2	0.1	0.6	—	—	—	—	—	—	—	—
Nickel oxide	—	0.2	—	—	—	—	—	—	—	—	—
Zinc oxide	—	—	—	—	—	—	—	—	8	5	—
Cryolite	—	—	—	7	12	10	—	—	—	3	6
Barium carbonate	—	—	—	—	—	—	—	—	—	—	4
Antimony oxide	—	—	—	—	—	4	—	—	—	—	4
Tin oxide	—	—	—	—	8	—	—	—	8	—	—
Red lead	—	—	—	—	—	—	4	—	—	30	—
White lead	—	—	—	—	—	—	—	—	12	—	—

The following notes were appended to these formulae, respectively :—(1) Hard ; (2) soft ; (3) medium ; (4) 8 per cent. tin oxide at mill ; (5) smelted in tin (fairly soft enamel) ; (6) 8 per cent. tin oxide at mill (antimony in melt) ; (7) 15 per cent. clay added on milling ; (8) lead-less type, very refractory, with mill addition of 30 per cent. quartz and 10 per cent. clay (sintered type) ; (9) 4 to 5 per cent. tin at mill (med. lead) ; (10) high lead ; and (11) lead-less.

(*To be continued*)

Correction.—In commenting on the changed name of the steelfoundry research organization in our issue of March 19, page 318, it was stated that Brigadier Levesley was connected with F. H. Lloyd & Company, Limited, whereas, of course, he is a director of Edgar Allen & Company, Limited. Apologies are tendered to both firms and all readers who have been inconvenienced.

Ban on Strategic Goods to China

The carriage of strategic goods to China from any source in British ships is prohibited under the Control of Trade by Sea (China and North Korea) Order, 1953, which was laid before Parliament recently by the Minister of Transport, Mr. Lennox-Boyd.

The complete list of strategic goods is as follows:—

ARMS, MUNITIONS, ETC.—Arms and munitions; aircraft and aero-engines; explosives and detonators; military equipment; minesweeping equipment.

ELECTRICAL AND ELECTRONIC EQUIPMENT.—Electric furnaces; electric transformers, generators, and motors, and switchgear for such equipment; radar and other radio-location equipment; radio, telephone, and telegraph equipment, including cables, but excluding domestic receiving sets; under-water location apparatus; welding machines and equipment, including electrodes.

MACHINERY AND INDUSTRIAL EQUIPMENT.—Asbestos (in particular asbestos yarn, textiles and clothing); ball and roller bearings; concrete mixing and handling plant; conveyor belting; cranes; crushing, grinding, pulverizing, and screening plant; cylinders and containers for compressed or liquefied gases; diamond tools and industrial diamonds; excavating and earth-moving equipment (in particular crawler tractors, scrapers, graders, and dumpers); flexible metal tubing; internal combustion engines, and components, and spares for such engines; metal rolling mills; metal working machinery and machine tools, including cutting and working tools for use therewith; scientific, laboratory, surveying and electrical instruments; turbines; valves, pumps, compressors, blowers, and centrifuges.

METALS (1).—Iron and steel (except manufactured articles not specified elsewhere in the list) including:—pig-iron, ingot steel; iron and steel scrap; semi-finished and finished iron and steel, including alloy steel (in particular, ingots, castings, billets, pipes, tubes, plates, angles, and girders); barbed wire, and steel wire strand and cable; tinplate.

(2).—The following metals, and alloys wholly or mainly thereof, including ferro-alloys and scrap, but excluding manufactured articles not mentioned elsewhere in this list:—Aluminium, beryllium, bismuth, cadmium, calcium, cerium, cobalt, columbium (niobium), copper, germanium, lead, magnesium, mercury, molybdenum, nickel, sodium, strontium, tantalum, tin, tungsten, vanadium, zinc, zirconium.

(3).—Uranium and thorium and their compounds, and the following ores: Pitchblende, antunite, carnotite, torbenite, monazite, uraninite, thorianite, and thorite.

OIL, RUBBER, AND CHEMICALS.—Crude petroleum, fuel oil, Diesel oil, petrol (motor and aviation), kerosene, lubricating oils and greases; natural and synthetic rubber; tyres and inner tubes, except those for pedal cycles; ammonium nitrate; benzene; calcium carbide; carbon black; glycerine; nitric acid; phenol; phosphorus (except red); picric acid; sulphur; tetra-ethyl lead.

TRANSPORT AND MARINE EQUIPMENT.—Rails, locomotives, and rolling stock, and wheels and axles thereof; motor vehicles (including tractors and motor-cycles), trailers, and components and spares for such motor vehicles and trailers; water craft of all kinds; gyro compasses and gyro repeaters.

Welding of Aluminium

A series of demonstrations on "The Welding of Aluminium Alloys by the Latest Production Techniques" is being arranged by the Northern Aluminium Company, Limited, Banbury, at various centres. At each the welding of aluminium by the shielded inert gas metal arc and the argon tungsten arc processes will be demonstrated, followed by the first showing in this country of two films, "Aircomatic Welding" and "The Study of Arcs in Sigma Welding." The programme will conclude with a discussion.

The first demonstration was held on March 18 at Slough; others followed on March 25, at the Government Training Centre, Bilton Way, Ordnance Road, Enfield Highway (Middx), and on April 1, at the Southampton Technical College, St. Mary's Street, Southampton. Arrangements are being made to hold subsequent demonstrations at Bristol, Cardiff, Birmingham, Liverpool, Manchester, Leeds, Sheffield, Newcastle, and Glasgow within the next few months.

Departmental Expenditure

A net reduction of £91,791,285 on the figure for 1952-53 is shown in the Civil Estimates for 1953-54 of the Ministries of Materials and Supply, and the Board of Trade, published last week. Reductions of nearly £25,000,000 in expenditure on strategic reserves and of £32,689,990 on the trading services of the Ministry of Materials contribute heavily to this figure. Purchase and storage of materials for strategic reserves will cost £42,600,000, against £65,300,000 in 1952-53. During the next financial year expenditure and receipts from the trading services are expected to balance each other, while during 1952-53 the cost of purchases, freight, storage, etc., exceeded receipts from sales by £32,700,000.

The only substantial increase is one of more than £10,000,000 on the Ministry of Supply vote, in which the principal increase is one of more than £26,000,000 on research and development. The major decrease is one of £21,000,000 on plant and machinery, mainly caused by a reduction in the provision for setting up a pool of machine tools and ancillary equipment in connection with the defence programme. The waiving of import duties on most steel products has led to a reduction of assistance to industry in this respect from £11,100,000 to £100,000.

February Imports and Exports

The table of import and export price index numbers for February, 1953, shows that while the export price index remained at the January figure of 98 (1952 =100) the index of import prices, at 91 was two points lower than in the previous month. As a result there was an improvement in the terms of trade of 2 per cent.

The import index for raw materials and materials mainly manufactured fell by two points to 87; reductions in the prices of arrivals were fairly general in this class, zinc ore and concentrates, and pitprops being among the commodities contributing most to the reduction. The price index for imports of manufactured goods at 91 was also two points lower.

Exports of iron and steel and manufactures averaged 6 per cent. less in January and February than in the last three months of 1952. Most of this reduction was in exports to Canada. Exports of engineering products fell by 2 per cent., the reduction being shared equally between exports of machinery and vehicles. There was, however, within these categories an increase in the export of electrical motors and parts and a 10 per cent. increase in aircraft exports. (See Iron and Steel Imports and Exports, page 398.)

Newton Chambers' Profit Increase

A preliminary statement of accounts for 1952 issued by Newton Chambers & Company, Limited, shows an increase in gross profit from £577,292 to £671,973. A final dividend of 17½ per cent. is recommended, making 25 per cent., less tax, for the year on the £750,000 capital (in preference and ordinary shares) as increased by the capitalization of £50,000 last May. For the previous year a similar total, paid on the smaller capital, included a bonus of 5 per cent.

The directors also propose to capitalize £50,000 of the reserves, to be distributed to preference and ordinary shareholders in proportion to their holdings on April 30, 1953. The annual meeting of the company is to be held on May 14.

Human Factors in Industry

Joint Committees Set Up

Two committees to work on human problems in industry have been set up jointly by the Department of Scientific and Industrial Research and the Medical Research Council. One will deal with human factors in individual efficiency and the other with human relations. The division of interest between them is broadly that the first will study the individual worker and his job and the second such things as the relation between the manager and the worker, between the worker and his mates and between the foreman and the technical specialist. The subjects which will concern the two committees can be listed under four headings. The first three are in general the responsibility of the committee on industrial efficiency. The fourth is that of the committee on human relations:—

(1) *Fitting the job to the man.* This means work on the design of tools and working equipment to suit the man who uses them (this is getting more important as machines become more complicated), time- and motion-study, the effect of factory lighting and heating, noise and so on, on performance.

(2) *Selection and training.*

(3) *Assessing the job.* This is concerned with such things as work measurement, job appraisal, time- and motion-study as a means of assessing a fair day's work, etc.

(4) *Human behaviour and human relations.* This includes joint consultation, attitudes to work and the structure of informal groups in the factory.

For research on matters relating to occupational health, the Medical Research Council will continue to be responsible, advised by its own special committees. However, in order to secure co-operation on technical aspects the D.S.I.R. will be asked to appoint assessors to these committees where appropriate. For example, the elimination of dust from factories, although primarily a medical problem, may bring in the D.S.I.R. or the research associations to develop means of combating dust.

The importance of taking full account of scientific study of the human factors in industry is becoming more widely appreciated. Much knowledge of the subject is already available, but not nearly enough. Notable contributions have come from the past researches of the Medical Research Council's industrial health research board; for instance, their studies of how hours of work affect output and health, the influence of environmental factors such as lighting and heating, and the effects of incentives. The post-war committee on Industrial Productivity's Panel on Human Factors also produced important studies, including one of the foreman in British industry and others on joint consultation.

The aim of the committees' work will be to develop knowledge which can be used to make hard and fast recommendations. This will help a firm which is, say, introducing a new process or new equipment to get it working smoothly in the shortest possible time and with the fullest co-operation between everyone concerned. The underlying object is to apply the results of the work to improve production in this country. For this reason, the committees include persons from industry, trades unions and universities.

Terms of Reference

The terms of reference of the two committees are as follows:—

Committee on Individual Efficiency in Industry. (1) To keep under review the progress of knowledge bearing on the technical efficiency of the individual in industry; (2) to advise on general policy in research, including applied research and field study; (3) to call attention to gaps, and make recommendations for filling them; and (4) to consider and report from time to time on the requirements for the training of research workers and technologists in this field.

Committee on Human Relations in Industry. To examine current activities concerning the study of human relations in industry and to call attention to problems of special timeliness or promise on which research, including applied research and field study, might be undertaken or supported by the Department of Scientific and Industrial Research, the Medical Research Council, or other bodies.

The chairman of the first committee is Sir Frederick Bartlett, C.B.E., M.A., F.R.S., lately Professor of Experimental Psychology, University of Cambridge, whilst Mr. A. B. Waring, managing director of Joseph Lucas Industries, Limited, presides over the second.

Where will the Money come from?

Few people are better equipped to talk about the relationship between industry and insurance company investment than Mr. E. H. Lever, chairman of the Steel Company of Wales, Limited, and of Richard Thomas & Baldwins, Limited. From the start of his business life until 1940 Mr. Lever was in the Prudential Assurance Company, Limited, being joint secretary from 1931. Addressing the Port Talbot committee of the Industrial Life Offices last week, he pointed out that the scale of modern industrial organization, certainly in basic industries, but not much less in the processing industries of industrial engineering—which depends on steel—had become much larger. Units were larger, the breadth of operations was larger, and when money was wanted it was wanted on a correspondingly larger scale.

He quoted the Steel Company of Wales as an example. It had already spent £70,000,000 to £80,000,000 on development and was embarking on further expenditure of at least £40,000,000. The size of the financial operation was not the whole trouble for industry generally. Each such capital project was a liability which had to be completed, and the present system of controls and licences made it impossible to decide when the job should begin and how long it would take. It was important, therefore, to be able to count on having the money when and as it was needed.

Mr. Lever recognizes the fact that industrial concerns will have to continue to plough back more earnings than they used to do, which makes it more difficult to attract money from the open market. Some of the additional capital must come from outside. "Given that individual savings have largely disappeared," said Mr. Lever, "it is clear that there is only one main source available—namely the investing institutions—in which the group of insurance companies is outstanding."

Institute of Industrial Supervisors

At the annual meeting of the Institute of Industrial Supervisors held on March 28. Sir Percy H. Mills, K.B.E., managing director of W. & T. Avery, Limited, was re-elected president for a further year. Sir Percy also is deputy president of the Association of British Chambers of Commerce and chairman of the National Research Development Corporation. Mr. J. K. Evans, labour officer, Imperial Chemical Industries, Metals Division, Birmingham, was elected chairman of the Institute's Council at the same meeting.

Another year of progress was reported by the Institute which now has over 20 local sections.

Ironfoundry *v.* Iron and Steel Industry

(From our Scottish Correspondent)

Scottish ironfounders, like many founders south of the border, are by no means in love with the Government's intention to resuscitate the Iron and Steel Board and to give it far-reaching powers over the whole iron and steel industry, including iron foundries. Their fears are hardly likely to be stilled by the assurance of the Minister of Supply, in reply to representations, that he recognizes the special position of the iron foundries, especially those operated by engineering factories.

The fact that he added that the main reason for putting iron foundries under the revived and strengthened Board was that they were large consumers of the same raw materials—namely scrap and pig-iron—as the steel producers, indicates that he far from appreciates that special position. From Westminster it may seem rational enough to consider the whole iron and steel industry as one unit, and thus to seek to deal with raw material problems on the broadest possible basis. The stumbling-block is that the ironfounders and the steel producers look on raw materials, and particularly scrap, from completely different viewpoints.

For many years now, the theory behind the scrap policy of the big steel makers is that the tonnage brought in is as good as independent of the price. Recently, Mr. Robert Stone, director of the British Iron and Steel Federation, claimed that, in spite of the controlled price for steelmaking scrap, " the degree of scrap collection here is at least as high as anywhere else in the world." Such things as the shipment of two thousand tons of scrap from the Clyde to Spain, a couple of weeks ago, are not considered to have any substantial bearing on the general proposition. The heavy steel makers take the view that events throw up a certain tonnage of scrap and that offering big money would make no difference to their supplies; certainly not enough to justify spending appreciably more cash. That may or may not be so. At any rate while the steel trade has never had anything like enough scrap these last two years and has had to cut output, the low scrap prices have enabled it to keep down its costs.

Scrap for Iron Foundries

The attitude of the ironfoundry industry to scrap is quite different. Ironfounders are no keener than anyone else to spend more cash than they need, but they work on the premise that scrap is where you can get it. Since the Act which tied up the major iron- and steelmaking firms in a bulky parcel actually loosened the bonds on the concerns that were left out, ironfounders are able to follow a much more active policy on scrap. Unlike nationalized concerns, which must work strictly to rule, they can offer extra inducements, like good delivery dates, to customer firms who show interest in returning scrap promptly.

To the average scrap merchant, iron foundries are considered to be a better outlet for prepared scrap than the steel works. And the foundry representatives, on their rounds, have the opportunity for rooting out, or at least reporting, otherwise-neglected deposits. The production figures speak for themselves. In 1951, the newly-nationalized steel industry fell short of its 16 million tons target by 360,000 tons of ingots. The ironfoundry trade, with its slight portion of newly-found freedom, put up its output tonnage of metal by just that amount.

At the time it was argued from the general direction of Steel House that, if the ironfounders had managed to make do with their former tonnage of scrap and pig-iron, the steelmakers would have reached their target. That argument apparently moved the Ministry of Supply, for pressure was put on some of the big foundry firms to part with some of their " supposed-to-be-excessive " stocks of scrap to the steel works. One Scottish firm which sustains its engineering business on foundry products of its own make was induced to deliver 1,000 tons of scrap to a nearby steel plant.

To the steelmakers the price of scrap is, if not all important, of great moment. To the ironfounders it is tonnage that matters consistent with reasonable quality. To a company like Glenfield & Kennedy, Limited, of Kilmarnock, 300 tons of foundry-melting materials suffices to keep their labour force of 2,500 busy for a week. That tonnage would be a " mere bagatelle " for the 1,800 or so men at Clydebridge Steel Works who turned out a record of some 10,500 tons of ingots recently.

Ironfounders are apparently not greatly exercised about the possibility of the Iron and Steel Board interfering with the details of their business. What they fear is that the Board will deal with raw materials with majestic impartiality. Even with the promise that at least one member of the Board will have foundry experience, more is likely to be heard from the ironfounders, notably the engineer-cum-founders, before the Government's Bill passes into law.

Progress at Poole Foundry

Speaking at a dinner and social evening given to about 80 members of the Poole works of John Harper & Company, Limited (formerly Poole Foundry). Mr. H. Field (director) said that many workers had spent up to 50 yrs. with the parent company at Willenhall, which was founded in the eighteenth century. When the firm took over the Poole branch, said Mr. W. H. Harper (managing director), he had stressed the need for high quality, high production and, with those, high wages. So far as quality went, the Willenhall management were most impressed by what had been achieved in 18 months. He hoped the men were satisfied with their wages, but he wanted to see higher production and higher wages still. Mr. A. T. Mason (branch manager), who was responsible for the evening's arrangements, proposing the health of the guests, thanked the directors and visitors from Willenhall for their constant co-operation and support. Responding, Mr. W. Woodhouse (foreman at the Poole works) paid tribute to Mr. Mason's work and said it had infused new life into the old undertaking.

Lunch on the Line at the B.I.F.

What is believed to be the first large-scale experiment in this country in catering on location by railway cars will be carried out at the British Industries Fair, which takes place from April 27 to May 8. Seven Pullman dining coaches of the latest type, including a bar car, will be stationed on the private siding of the B.I.F. engineering section at Castle Bromwich, Birmingham, and will supplement the 25,000 meals served daily during the fair. This supplementary service has been arranged at the invitation of, and in collaboration with, the official caterers at Castle Bromwich, who have done the catering for 30 years. The new service is intended mainly for exhibitors, who will be invited to join a " B.I.F. Pullman Club " and take their customers.

Personal

MR. G. DIXON-LEWIS has been appointed research chemist in the Department of Coal Gas and Fuel Industries at the University of Leeds.

MR. F. R. MILLER, manager since 1943 of the transport department of the General Electric Company, Limited, is retiring after 46 years with the company.

MR. R. A. COOKSON, joint managing director of Goodlass Wall & Lead Industries, Limited, and a director of several colliery and other companies, has been elected to the north-eastern district board of Martins Bank, Limited.

MR. C. W. MURRY, managing director of George Fletcher & Company, Limited, engineers and manufacturers of sugar refinery machinery, Litchurch Lane, Derby, is on his way by air to the West Indies, where he will attend the congress of the International Society of Sugar Cane Technologists.

CROMPTON PARKINSON, LIMITED, announce that Mr. C. A. J. Martin, G.C., M.C., B.A., A.M.I.E.E., general sales manager of the plant division, home sales; Mr. M. H. L. Lewis, M.A. (OXON), assistant to the works director (south); and Mr. Michael Parkinson, M.A. (CANTAB), assistant to the works director (north), have been co-opted to the Board of executive directors for a period of one year.

DR. THOMAS KING has been appointed assistant professor in metallurgy at Massachusetts University of Technoolgy, Boston, U.S., and will take up his appointment in September. He studied at the Royal Technical College, Glasgow, and in 1951 won the Dr. James Mackenzie Prize presented to the outstanding research student of the year at the college, where he has been a lecturer in metallurgy. He is 29.

Richard Thomas & Baldwins, Limited, have announced the retirement of MR. LESLIE JOHN DAVIES from the post of assistant managing director of the company. Mr. Davies, who is 66, will, however, retain his seat on the board. He has been succeeded as assistant managing director by MR. G. A. YOUNG, general manager of the Ebbw Vale section. Mr. Young has also been appointed a director of the Steel Company of Wales. MR. CHARLES G. GILBERTSON has retired from the board of Richard Thomas & Baldwins owing to ill health.

MR. M. W. THRING, assistant director of the British Iron and Steel Research Association, has been appointed to succeed Professor R. J. Sarjant as Professor of Fuel Technology at Sheffield University. Mr. Thring joined the British Coal Utilisation Research Association in 1937, and seven years later became head of its combustion research laboratory. He joined the British Iron and Steel Research Association in 1946 as head of its physics department. Prof. Sarjant, who is retiring at the end of the present session, has held the chair of Fuel Technology since 1946. He was previously head of the research department at Hadfields, Limited, Sheffield.

Obituary

MR. J. C. HUGHES, senior partner in J. C. Hughes & Partners, consulting engineers, of London, N.W.1, died on March 11.

MR. JOHN HUTTON, managing director of J. Hutton & Company, Limited, machine-tool manufacturers, of Glasgow, died recently.

MR. ARTHUR WHITTAKER, a director of Ferranti, Limited, founders and electrical engineers, of Hollinwood (Lancs), has died.

MR. FRANCIS WILLIAM LEWIS, a director of A. Boake Roberts & Company, Limited, industrial chemical manufacturers, of London, E.15, since 1921, died on March 14.

SIR DAVID ANDERSON, the consulting engineer, who died at his home near Cupar, Fife, at the age of 73, designed and supervised the construction of the Mersey Tunnel. His most recent work included designs for the proposed road bridges over the Forth and Severn. Sir David, who specialized in bridges and tunnels, also designed the high-level bridge over the Tyne, the proposed tunnel under the Tyne, and other bridges in Sunderland and North Wales. A former president of the Institution of Civil Engineers, he was consultant to the London Transport Executive. Senior partner in the firm of Mott, Hay & Anderson, consulting engineers, London, Sir David had maintained a staff at his home for the past three years in connection with work of the Forth road bridge.

Publications Received

Coke Manufacture in Great Britain by S. H. Beaver, M.A. A reprint from transactions and papers, 1951, of the Institute of British Geographers.

This is a historical account of the development of the coke industry since its first utilization by Abraham Darby.

Department of Scientific and Industrial Research Report 1951-52. Published by H.M. Stationery Office. Price 8s. net.

This book gives information as to what is thought in official quarters about the organization and year's working of the government-sponsored research associations, with notes on their finances. For one of these bodies, much detail is printed covering foundry research, but for another only one line appears. The Advisory Council have expressed their disappointment at the meagre amount of long-term basic scientific research being undertaken, but have commended such activities as the visits to foundries by the operational research team—and rightly so.

Journal of Research and Development. Vol. 4, No. 10. Feb., 1953. Published by the British Cast Iron Research Association, Alvechurch, Birmingham.

The first of the two Reports printed in this issue is by Mr. G. N. J. Gilbert, and outlines the influence of silicon and phosphorus on the resistance to impact of ferritic nodular iron. If the silicon content of the material exceeds *circa* 2.4 per cent. notch brittleness makes its appearance. Phosphorus, too, has an embrittling effect.

The second Report is from Mr. E. R. Evans, who details: "Some Observations on the Production of Vitreous-enamelled Iron Castings." The author has attributed defects to inefficiency in the sand control by the foundry and a similar laxity by the enamellers. The reviewer was intrigued by the statement that "one plant added as much as 75 per cent. [of new sand], and would have welcomed news as to whether the castings were in this case freer from defects. For the best finished castings he has ever seen, nothing but new sand was used. The No. 10 issue well maintains the high standard now invariably associated with this bi-monthly publication.

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Imports and Exports of Iron and Steel in February

The following tables, based on Board of Trade returns, give figures of imports and exports of iron and steel in February. Figures for the same month in 1952 are given for the purpose of comparison, and totals for the first two months of 1952 and 1953 are also included. (All figures in tons.)

Total Exports of Iron and Steel by Destination

Destination.	Month ended February 28.		Two months ended February 28.	
	1952.	1953.	1952.	1953.
Channel Islands	538	487	1,169	1,198
Gibraltar	83	35	138	529
Malta and Gozo	185	461	408	849
Cyprus	528	866	667	2,798
Sierra Leone	421	314	833	731
Gold Coast	2,217	2,420	6,582	6,802
Nigeria	6,237	3,546	9,739	9,057
Union of South Africa	13,541	11,156	24,497	27,311
Northern Rhodesia	2,945	2,480	5,240	5,523
Southern Rhodesia	2,207	2,724	7,349	8,628
Tanganyika	2,145	2,018	4,455	4,238
Kenya	3,724	4,776	8,603	13,114
Uganda	644	673	1,772	1,432
Mauritius	398	762	1,013	1,710
Bahrein, Qatar, and Trucial Oman	583	1,271	2,157	4,654
Kuwait	1,265	2,154	3,944	4,388
India	4,823	5,496	10,754	12,577
Pakistan	5,547	3,201	10,430	9,493
Malaya	5,882	6,045	14,033	12,034
Ceylon	1,834	2,024	3,555	3,764
North Borneo	246	904	604	1,420
Hongkong	985	3,137	2,784	4,992
Australia	27,116	17,856	57,947	45,253
New Zealand	14,495	11,153	25,319	23,761
Canada	14,479	8,635	27,116	19,370
Jamaica	1,195	1,787	4,375	4,428
Trinidad	4,118	3,200	9,229	9,661
British Guiana	405	252	867	706
Anglo-Egyptian Sudan	1,566	1,852	2,409	4,132
Other Commonwealth	2,026	6,119	5,539	13,683
Irish Republic	5,094	4,942	10,723	10,507
Soviet Union	—	2	1	2
Finland	6,899	2,689	11,417	6,737
Sweden	6,540	6,448	18,636	12,977
Norway	3,474	4,352	9,747	9,996
Iceland	109	328	307	358
Denmark	8,123	5,961	17,000	17,658
Poland	21	38	32	94
Western Germany	45	187	326	336
Netherlands	5,425	8,507	13,118	24,168
Belgium	483	2,001	1,360	4,142
France	227	1,063	564	1,615
Switzerland	538	578	1,418	1,348
Portugal	869	1,279	1,649	3,775
Spain	345	438	637	758
Italy	1,414	7,204	4,459	9,314
Austria	36	62	103	270
Yugoslavia	858	616	1,268	681
Greece	397	406	1,011	563
Turkey	520	950	1,204	2,008
Netherlands Antilles	1,008	1,304	2,650	3,334
Belgian Congo	169	384	461	487
Angola	85	231	1,599	277
Portuguese E. Africa	454	249	803	656
Canary Islands	156	110	239	247
Syria	238	25	272	43
Lebanon	1,526	1,243	2,117	1,373
Israel	2,616	953	3,442	1,923
Egypt	3,670	956	7,736	3,154
Saudi Arabia	398	336	913	518
Iraq	5,778	5,585	10,053	12,187
Iran	200	537	2,309	850
Burma	1,376	2,000	2,537	2,853
Thailand	939	1,415	1,501	2,382
Indonesia	957	1,152	1,734	2,177
China	—	3	—	3
Philippine Republic	536	512	1,064	536
U.S.A.	9,861	4,759	12,510	6,275
Cuba	192	113	468	526
Colombia	278	357	820	1,423
Venezuela	3,879	3,669	7,834	10,026
Ecuador	254	212	926	713
Peru	549	1,434	1,424	2,285
Chile	246	117	748	651
Brazil	1,937	343	2,940	1,053
Uruguay	778	54	1,043	193
Argentina	4,046	662	6,524	2,114
Other foreign	1,961	2,451	3,362	3,884
TOTAL	207,882	187,021	426,536	427,686

Total Imports of Iron and Steel and Origin

From	Month ended February 28.		Two months ended February 28.	
	1952.	1953.	1952.	1953.
India	—	—	44	67
Canada	3,622	11,738	8,034	24,482
Other Commonwealth countries and the Irish Republic	128	5,499	947	14,578
Sweden	2,421	1,449	4,389	4,235
Norway	4,929	5,139	9,986	10,509
Western Germany	7,676	1,484	15,264	4,593
Netherlands	13,402	6,832	21,472	15,048
Belgium	26,684	16,718	45,689	55,845
Luxembourg	18,007	8,971	26,724	27,602
France	15,897	30,209	48,563	50,045
Italy	365	2,825	1,713	2,849
Austria	12,128	27,051	20,146	50,937
Japan	10,574	6,133	13,694	10,070
U.S.A.	17,320	21,997	28,580	65,466
Other foreign countries	113	90	378	9,826
TOTAL	133,268	146,135	245,623	346,152
Iron and steel scrap and waste, fit only for the recovery of metal	35,886	55,828	86,186	124,415

Exports of Iron and Steel, by Product

Product.	Month ended February 28.		Two months ended February 28.	
	1952.	1953.	1952.	1953.
Pig-iron	232	304	633	604
Ferro-tungsten	28	5	28	21
Other ferro-alloys	235	290	435	498
Ingots, blooms, billets, and slabs	5	29	77	46
Iron bars and rods	283	220	678	452
Steel and tinplate bars and wire rods	41	851	375	2,456
Bright steel bars	735	1,665	2,309	3,587
Alloy steel bars and rods	1,006	1,375	2,603	2,994
Other steel bars and rods	9,902	8,969	20,099	19,313
Angles, shapes, and sections	10,813	8,051	22,963	23,102
Iron and other castings and forgings	1,011	1,107	2,126	2,028
Girders, beams, joists, and pillars (rolled)	3,008	2,135	6,544	4,155
Hoop and strip	4,539	6,030	8,661	9,444
Iron plates and sheets	58	1	64	58
Tinplate	22,375	23,482	46,203	48,677
Tinned sheets	109	258	274	419
Terneplates and decorated tinplates	37	88	109	310
Other steel plate ($\frac{1}{8}$ in. thick and over)	19,247	16,456	39,351	39,172
Galvanized sheets	5,129	8,000	10,882	15,785
Black sheets	10,269	7,634	24,266	20,856
Other coated plates and sheets	496	978	1,471	1,779
Cast-iron pipes up to 6 in. dia.	7,013	6,086	15,552	14,074
Do., over 6 in. dia.	3,450	3,221	10,319	9,562
Wrought-iron tubes	42,014	34,686	76,095	74,765
Railway material	15,913	14,378	32,835	38,596
Wire	4,348	4,103	9,412	8,736
Cable and rope	2,541	2,934	4,828	6,089
Wire nails, etc.	908	887	2,123	1,562
Other nails, tacks, etc.	613	257	1,345	605
Rivets and washers	509	496	1,007	892
Wood screws	282	169	715	423
Bolts, nuts, and metal screws	2,418	1,482	4,846	3,274
Baths	1,841	327	3,448	746
Anchors, etc.	977	802	2,048	2,054
Chains, etc.	849	735	1,868	1,679
Springs	339	350	1,044	755
Holloware	7,034	6,805	15,307	17,523
Doors and windows	1,684	1,662	3,746	3,817
TOTAL, including other manufactures not listed above	207,882	187,021	426,536	427,686

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News in Brief

A SCHEME for a new engineers' workshop at Clowne Technical Institute has been approved by the Ministry of Education.

PREPARATION of the iron and steel industry's second post-war development plan is almost complete. It will cover the next five years and will cost about £250,000,000 at early-1952 prices. Home steel production is to be increased to almost 20,500,000 tons.

EIGHT SPRAY BATHS for employees at the iron foundry of Shaw & McInnes, Limited, Firhill, Glasgow, were declared open on March 23 by Miss A. G. Dennistoun, Chief Inspector of Factories for Glasgow, Mr. R. J. Lightbody, managing director of the company, presided.

FOLLOWING THE DECISION of Ripley (Derbys) Urban Council not to proceed with the provision of a coat of arms and chain of office for the town, the Butterley Company, Limited, Butterley Ironworks, have offered to defray the cost of a coat of arms, to commemorate Coronation year.

FURNACE BODIES for a 600-ton mixer and three 350-ton tilting furnaces for the new Spanish national iron and steel works to be built at Avilés are to be made by the heavy castings division of Newton Chambers & Company, Limited, Thorncliffe, near Sheffield. The firm has orders for about 1,000 tons of structural steelwork for the new works.

UNDER THE CHAIRMANSHIP of Mr. Harry Upton, a Midland branch of the Institute of Marine Engineers has been formed in Birmingham. Secretary of the new branch is Mr. Tom Strand, of B.T.H. Marine Department, Rugby. A programme of papers, factory visits and an outing to the Marine Exhibition in London in September, is being planned for members.

AT A MEETING of the Bradford Further Education Sub-committee last week, it was reported that the Bradford Gas Engine Company, Limited, of Shipley, had presented a Diesel engine, worth £180, to the Engineering Department of the Bradford Technical College, and that the Ford Motor Company had also made a gift of two Ford chassis (one sectional) for the Department of Motor Engineering at the same college.

MR. F. SCOPES, managing director of the Stanton Ironworks, Stanton-by-Dale, presented gold watches to 118 employees who had completed 30 years' service with the company; 48 of the watches went to employees at the Holwell, Riddings and Cochrances departments. At the presentation, Mr. Scopes was assisted by Mr. P. H. Wilkinson, O.B.E., deputy manager, and Mr. A. Watson, assistant manager.

GUEST SPEAKERS at the annual dinner/dance of the Birmingham section of the Institution of Production Engineers in Birmingham on March 21 included Sir Cecil Weir, national president of the Institution; Mr. J. France, president of the Birmingham section; Lord Sempill, a past-president of the Institution; Dr. H. F. Humphreys, vice-chancellor of Birmingham University, and the Lord Mayor of Birmingham (Ald. W. T. Bowen).

MR. H. F. SPENCER, managing director of Richard Thomas & Baldwins, Limited, proposed the toast of "The Institute" at the annual dinner in Birmingham on March 26 of the Birmingham branch of the Institute of Cost and Works Accountants. He welcomed the establishment of the Institute's Fellowship in management accounting introduced this year, and said it was not only a post-graduate diploma but a certificate of efficiency in the affairs of practical management.

MANUFACTURING capacity throughout the world is outstripping the supply of raw materials. Although production of raw materials in 1950 was only some 10 per cent. higher than in the five years immediately preceding the outbreak of war, manufacturing capacity has increased by about 40 per cent. According to the new edition of the Royal Institute of International Affairs' information paper on world production of raw materials, the world is threatened not so much with the problem of mass starvation as with mass unemployment.

THE FOLLOWING DERBY FIRMS will have their own stands at the British Industries Fair at Castle Bromwich:—Ley's Malleable Castings Company, Limited, and the Ewart Chainbelt Company, Limited; Spiral Tube Components Company, Limited; Aiton & Company, Limited, pipe engineers; Qualcast, Limited, and International Combustion, Limited, with its subsidiary, The Riley Stoker Company, Limited. Other Derbyshire firms will include Glow Worm Boilers, Limited, Milford; Park Foundry, Belper; Stanton Ironworks Company, Limited, Ilkeston.

BRITISH INSULATED CALLENDER'S CABLES, LIMITED, announce that plans for the formation of a subsidiary company in Australia, "British Insulated Callender's Cables (Australia) Pty., Limited," have been completed. The authorized capital is £A1,000,000, of which £A400,000 has been issued, and the registered office is at 84/88, William Street, Melbourne, C.I., Victoria, with branches in other Australian states. Sir T. Malcolm Ritchie, M.I.E.AUST., will be the first chairman of the board, which will consist of prominent Australians and the B.I.C.C. Resident Executives in Australia.

AT THE ANNUAL DINNER AND SOCIAL recently given by the directors of John Smith (Keighley), Limited, crane makers, of Keighley, at the Municipal Hall, there were over 350 employees, their wives, and guests. Among those present were Mr. Frank R. Stagg, chairman of the company, and deputy chairman of T. W. Ward, Limited, Sheffield (to which group the firm belongs). Mr. G. A. Smith, assistant managing director, making an appeal to employees for co-operation, told them that when the present crippling taxes were paid the firm's profit would be very little more than what was paid to them in bonuses and Christmas gifts.

G. & J. WEIR, LIMITED, the Glasgow engineers, have received an order from the Anglo-Iranian Oil Company, Limited for evaporating and distilling plant for their new refinery at Aden, to provide more than 1,700 tons of fresh water daily from sea water. The order, placed through George Wimpey & Company Limited, is for three units, each capable of producing 134,000 imperial gallons of distilled water a day from salt water taken from the Gulf of Aden, the total output being not less than 400,000 gallons each 24 hours, if required. Work on the order has already commenced at Cathcart, and it is expected that the work of erection at Aden will begin early in 1954.

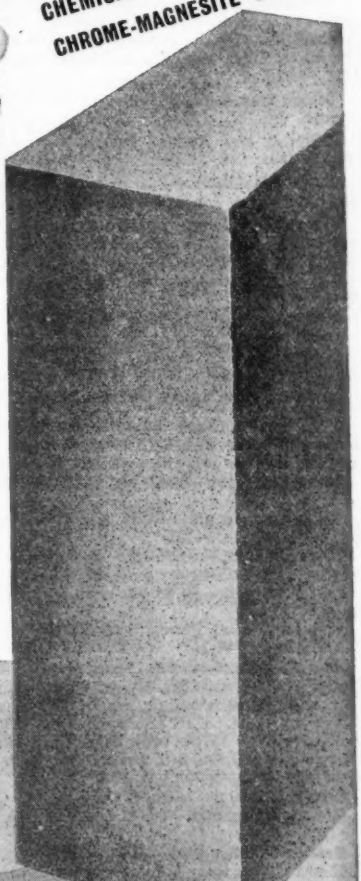
AT THE GOLDEN JUBILEE PARTY at the Tudor Restaurant, Grimsby, on March 20, of Harper, Phillips & Company, Limited, ironfounders, Albion Foundry, Eastgate, Grimsby, a commemorative gift of an inscribed breadknife was presented to each employee. The late Mr. Phillips took over the small foundry of Phillips & Company at Grimsby and established the present firm in 1903, and at the party his son, Mr. E. A. Phillips, the present managing director, said he hoped that his son, Graham, would be present at the company's centenary celebrations. Illuminated addresses were presented to six long-service employees and gifts were made by the company's employees to the directors.

OPEN HEARTH FURNACES

GR SAXPYRE 'D'

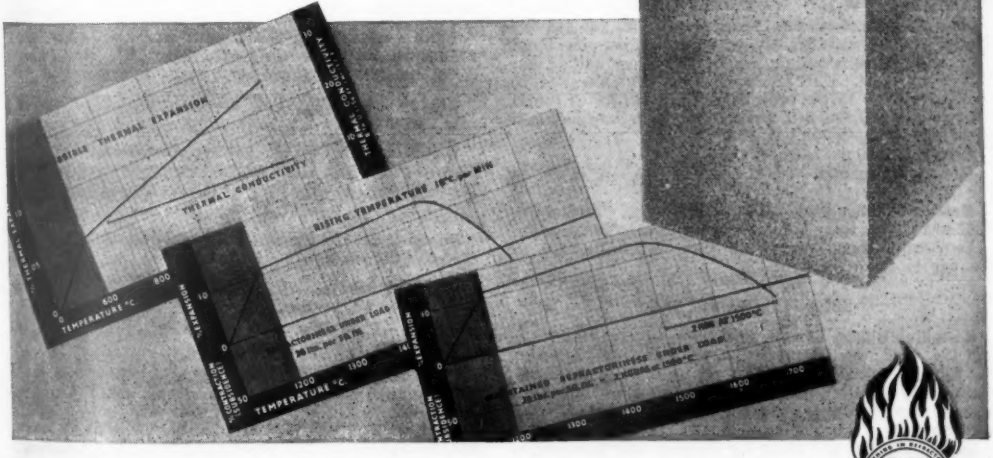
CHEMICALLY BONDED CHROME-MAGNESITE BRICKS

ELECTRIC FURNACES



G.R. SAXPYRE 'D' basic bricks are unfired, chemically bonded chrome-magnesite refractories, manufactured from carefully selected raw materials possessing requisite chemical and physical properties. They possess consistent and uniformly low porosity, high density and high crushing strength characteristics. G.R. Saxpyre 'D' has a number of important applications including back, front and end-wall positions and port ends in basic open-hearth furnaces, also the side walls of basic electric furnaces.

Technical advice and assistance in the selection and application of suitable refractories for all types of furnaces are available to users upon request.



GENERAL REFRACTORIES LTD

GENEFAX HOUSE · SHEFFIELD 10 · TELEPHONE: SHEFFIELD 31113

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Current Prices of Iron, Steel, and Non-ferrous Metals

(Delivered unless otherwise stated)

March 31, 1953

PIG-IRON

Foundry Iron.—No. 3 IRON, CLASS 2:—Middlesbrough, £13 18s.; Birmingham, £13 11s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £16 14s. 6d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £17 0s. 3d.

Scotch Iron.—No. 3 foundry, £16 11s., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £18 3s.; South Zone, £18 5s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £19 3s.; South Zone, £19 5s. 6d.

Hematite.—Si up to 2½ per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. Coast and N.-W. Coast of England, £16 12s.; Scotland (Scotch iron), £16 18s. 6d.; Sheffield, £17 13s.; Birmingham, £17 19s. 6d.; Wales (Welsh iron), £16 18s. 6d.

Basic Pig-iron.—£14 6s. 6d. all districts.

FERRO-ALLOYS

(Per ton unless otherwise stated, delivered).

Ferro-silicon (6-ton lots).—40/55 per cent., £57 10s., basis 45 per cent. Si, scale 21s. 6d. per unit; 70/84 per cent., £86, basis 75 per cent. Si, scale 23s. per unit.

Ferro-vanadium.—50/60 per cent., 23s. 8d. to 25s. per lb. of V.

Ferro-molybdenum.—65/75 per cent., carbon-free, 10s. to 11s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., carbon-free, £204 to £210 per ton; 38/40 per cent., £235 to £265 per ton.

Ferro-tungsten.—80/85 per cent., 22s. 10d. to 23s. 6d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 25s. 9d. to 28s. per lb. of W.

Ferro-chrome (6-ton lots).—4/6 per cent. C, £85 4s., basis 60 per cent. Cr, scale 28s. 3d. per unit: 6/8 per cent. C, £80 17s, basis 60 per cent. Cr, scale 26s. 9d. per unit; max. 2 per cent. C, 2s. per lb. Cr; max. 1 per cent. C, 2s. 2½d. per lb. Cr; max. 0.15 per cent. C, 2s. 3½d. per lb. Cr; max. 0.10 per cent. C, 2s. 3¾d. per lb. Cr; max. 0.06 per cent. C, 2s. 4d. per lb. Cr.

Cobalt.—98/99 per cent., 20s. per lb.

Metallic Chromium.—98/99 per cent., 6s. 5d. to 7s. 6d. per lb.

Metallic Manganese.—93/95 per cent., carbon-free, £262 to £275 per ton; 96/98 per cent., £280 to £295 per ton.

Ferro-columbium.—60/75 per cent., Nb + Ta, 40s. to 70s. per lb., Nb + Ta.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—BASIC: Soft, u.t., £25 12s. 6d.; tested, 0.08 to 0.25 per cent. C (100-ton lots), £26 2s. 6d.; hard (0.42 to 0.60 per cent. C), £28; silico-manganese, £33 16s.; free-cutting, £28 16s. 6d. SIEMENS MARTIN ACID: Up to 0.25 per cent. C, £32 12s.; case-hardening, £33; silico-manganese, £34 17s. 6d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.25 per cent. C, £29 16s.; basic, hard, over 0.41 up to 0.60 per cent. C, £30 16s.; acid, up to 0.25 per cent. C, £33.

Sheet and Tinplate Bars.—£25 11s. 6d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £30 6s.; boiler plates (N.-E. Coast), £31 14s.; floor plates (N.-E. Coast), £31 15s. 6d.; heavy joists, sections, and bars (angle basis), N.-E. Coast, £28 9s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., untested, £32 4s. 6d.; flats, 5 in. wide and under, £32 4s. 6d.; hoop and strip, £32 19s. 6d.; black sheets, 17/20 g., £41 6s.; galvanized corrugated sheets, 24 g., £51 7s. 6d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £51 14s. 3d.; nickel-chrome, £73 3s. 6d.; nickel-chrome-molybdenum, £80 18s. 3d.

Tinplates.—57s. 10d. per basis box.

NON-FERROUS METALS

Copper.—Electrolytic, £280; high-grade fire-refined, £279 10s.; fire-refined of not less than 99.7 per cent., £279; ditto, 99.2 per cent., £278 10s.; black hot-rolled wire rods, £289 12s. 6d.

Tin.—Cash, £910 to £912 10s.; three months, £895 to £900; settlement, £910.

Zinc.—April, £76 2s. 6d. to £76 5s.; July, £76 15s. to £76 17s. 6d.

Refined Pig-lead—April, £86 10s. to £86 15s.; July, £84 10s. to £85.

Zinc Sheets, etc.—Sheets, 15 g. and thicker, all English destinations, £106 10s.; rolled zinc (boiler plates), all English destinations, £104 10s.; zinc oxide (Red Seal), d/d buyers' premises, £110.

Other Metals.—Aluminium, ingots, £161; magnesium, ingots, 2s. 10½d. per lb.; antimony, English, 99 per cent., £225; quicksilver, ex warehouse, £70 10s. to £71 (nom.); nickel, £483.

Brass.—Solid-drawn tubes, 25½d. per lb.; rods, drawn, 33⅜d.; sheets to 10 w.g., 277s. per cwt.; wire, 31½d.; rolled metal, 263s. 9d. per cwt.

Copper Tubes, etc.—Solid-drawn tubes, 31⅞d. per lb.; wire, 312s. 3d. per cwt. basis; 20 s.w.g., 340s. 9d. per cwt.

Gunmetal.—Ingots to BS. 1400—LG2—1 (85/5/5/5), £197 to £218; BS. 1400—LG3—1 (86/7/5/2), £210 to £238; BS. 1400—G1—1 (88/10/2), £312 to £375; Admiralty GM (88/10/2), virgin quality, £320 to £380 per ton, delivered.

Phosphor-bronze Ingots.—P.Bl, £340 to £385; L.P.Bl, £245 to £275 per ton.

Phosphor Bronze.—Strip, 407s. 9d. per cwt.; sheets to 10 w.g. 428s. 9d. per cwt.; wire, 49½d. per lb.; rods, 44d., tubes, 42½d.; chill cast bars: solids 3s. 8d., cored 3s. 9d. (C. CLIFFORD & SON, LIMITED.)

Nickel Silver, etc.—Ingots for raising, 2s. 8½d. per lb. (7 per cent.) to 3s. 10½d. (30 per cent.); rolled metal, 3 in. to 9 in. wide × .056, 3s. 2½d. (7 per cent.) to 4s. 4½d. (30 per cent.); to 12 in. wide × .056, 3s. 2½d. to 4s. 5d.; to 25 in. wide × .056, 3s. 4½d. to 4s. 7d. Spoon and fork metal, unsheared, 2s. 11½d. to 4s. 1½d. Wire, 10 g., in coils, 3s. 9d. (10 per cent.) to 4s. 10½d. (30 per cent.). Special quality turning rod, 10 per cent., 3s. 8d.; 15 per cent., 4s. 1½d.; 18 per cent., 4s. 6½d. All prices are net.